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ABSTRACT

This document reports on the work of a task force charged with formulating recommendations on the kind of preparation an incoming student should have to assure successful entry to and completion of the freshman year of study at the State University of New York (SUNY). In addition, the task force was asked to specify what program of study and forms of assessment would enable the University to determine potential student qualifications. The task force recommends that students preparing to enroll in college should have entry-level skills in the areas of academic and personal support, information management, and communication, and should also have analytical or problem-solving skills. Entry-level knowledge should include humanities, arts, foreign languages, natural sciences, mathematics and technical studies, social sciences, and history. Each of these knowledge and skill areas are discussed in detail in the body of the report. The task force strongly endorses "performance-based" assessment which attempts to evaluate students by processes similar to those found in the work place. Also recommended are the establishment of a Mathematics Early Alert and Intervention Program and several changes in New York State Regents High School Curricula and Examinations. The report also suggests nine ways SUNY can encourage students to enhance the quality and productivity of their collegiate experience. Appendixes contain principles of a new compact for learning, analytical skills examples, modern languages for communications syllabus checkpoints, and knowledge area standards for mathematics. (Contains 28 references.) (JB)

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STATE UNIVERSITY OF NEW YORK

SUNY 2000

COLLEGE EXPECTATIONS:

The Report of the SUNY Task Force on College Entry-Level Knowledge and Skills

October 1992

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SUNY 2000

College Expectations: The Report of the SUNY Task Force on College Entry-Level Knowledge and Skills

October 1992

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CHANCELLOR'S LETTER

In *SUNY 2000: A Vision for the New Century*, we identified a number of critical areas of state needs, areas in which the University would renew and redouble its efforts to respond to the most pressing issues facing New Yorkers through the 1990's and into the twenty-first century. Of these, none is more important than public education which, in so many ways, serves as the foundation for our progress in all other endeavors.

Public educational systems here in New York, as in states across the country, are struggling with the problem of student preparation for college. Just as we celebrate the hard-won gains we have made in increasing accessibility to postsecondary educational opportunities for numbers of students unimagined barely one or two decades ago, we find ourselves increasingly challenged by the level of preparation with which so many of these new college entrants arrive on our campuses.

Unfortunately, too many in higher education have been too willing to lay blame for the inadequate or incomplete preparation of students on our often overburdened school colleagues, without asking ourselves what our responsibility might be to ensure better preparation. In *College Expectations: The Report of the SUNY Task Force on College Entry-Level Knowledge and Skills*, SUNY tackles that question in cooperation with school personnel and states forthrightly and in some detail the level of knowledge and skills we would like our incoming freshmen to have in order to enhance their prospects of success and opportunities for choice. The Report also addresses how this set of skills and knowledge might be assessed and how the University might encourage better-prepared students to accelerate through and enrich their college programs.

I believe *College Expectations* responds to the challenge of the Regents *New Compact for Learning* and should help to shape the new vision of secondary school learning outcomes in New York State. It should also promote the greater learning productivity in both schools and colleges that is essential for all our futures. I hope it will encourage others to join the great many SUNY faculty, staff, and students who are already engaged in extremely successful collaborative efforts with their local public schools. The Task Force has made an outstanding beginning; work with us in developing their ideas and helping to turn the vision of *SUNY 2000* into a reality.

D. Bruce Johnstone
Chancellor

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College Expectations: The Report of the SUNY Task Force on College Entry-Level Knowledge and Skills

> *Now that the student outcomes assessment movement is reaching the public schools, SUNY must lend its expertise in helping to determine what a high school graduate should know and be able to do and how to assess the graduate's level of mastery. This means becoming part of the incentive for students to stay in school and fulfill their academic potential rather than simply satisfy minimal standards* (SUNY 2000: A Vision for the New Century, *p. 49*).

The Context and Purpose of the Report

In 1991 the Board of Trustees and the Chancellor of the State University of New York defined in **SUNY 2000** a vision for the University at the beginning of the next century and adopted a series of goals and strategies to implement that vision. Their overriding principle was the unswerving commitment of the University to the maintenance of access and excellence. Perhaps nowhere does that commitment become more manifest than in the message the University sends to its prospective students: what may we in the University expect of them and what may they expect of us?

SUNY, along with the rest of American elementary, middle, and higher education, is hearing a new urgency in the calls for higher standards for students at all levels. There is also growing public and political pressure for greater accountability and clearer statements of what we expect and what we, in turn, deliver. Now more than ever, institutions of higher learning must articulate with more precision and clarity their expectations of students on entry to college. In order to promote excellence, these expectations should be framed in terms of high standards; and in order to maintain access, colleges should provide appropriate instructional opportunities and other academic support services for those individuals who can, with some developmental help, meet these expectations in a timely manner.

The work of this Task Force is one of several attempts currently under way in New York State to respond to these challenges. It focuses particularly upon the preparation needed for successful entry to and completion of the freshman year of study, for successful transition from pre-collegiate learning to college-level learning.

Following a series of discussions in 1990-91 between State University Chancellor D. Bruce Johnstone, Provost Joseph Burke, and New York State Commissioner of Education Thomas Sobol, the Task Force was created to respond to the call in the Regents *New Compact for Learning* for higher education to:

- collaborate in specifying the skills, knowledge, and understanding students in elementary, middle, and secondary schools need to acquire and in developing measures for assessing that acquisition; and
- collaborate with schools to motivate and prepare elementary, middle, and secondary students for higher education.

The Charge to the Task Force

The Task Force was charged to advise the Chancellor on the content and level of learning that would assure beginning students a reasonable chance of successfully completing a freshman year of collegiate study in a baccalaureate or associate degree program:

- What should a SUNY College or University entrant know and be able to do in order to be fully prepared for successful college-level work through the freshman year?
- What program of study and forms of assessment will enable the University to determine that prospective students have accomplished these expectations for successful entry-level collegiate study?

In determining the appropriate form of assessment of entry-level knowledge and skills, the Task Force was asked not to restrict its attention to minimum standards for entry to collegiate work. Students enter SUNY with wide ranges of preparation and the University must be ready to challenge the most able and best prepared as effectively as it assists those with deficiencies to reach the expected entry-level standards. The Task Force has therefore identified opportunties for enrichment and acceleration in response to its charge.

Recommended College Entry-Level Knowledge and Skills

A significant number of high school students may be unclear about whether they intend to go to college. The recommendations of the Task Force, therefore, urge all students to develop abilities and choose high school courses that preserve their options for later college success. Many students change their career plans and academic goals, many leave and return to college with different goals, and, as a result, the Task Force recommendations should inform them of the academic preparation that would support their widest range of future choices.

Further, the Task Force interpretation of "full preparation" in reference to the skills differs somewhat from that in knowledge areas. Insofar as every high school graduate may eventually wish or need to pursue some form of postsecondary education, we consider the skills described in the report to be worthy objectives of everyone who receives a high school diploma. The knowledge area recommendations more particularly pertain to college-bound students who plan to enter programs with a general education component.

In total, this Report paints a portrait of a student ideally prepared in each knowledge and skill area. It is therefore unlikely that any one student will meet all of these expectations. The closer students come to fitting the profile, however, the greater their chances to excel in a wide range of college majors.

The Task Force Report delineates college-going skills and knowledge in the areas listed below. Each area listing is followed by the number(s) of the page(s) on which the relevant skills are described.

Entry-Level Skills

- Academic and Personal Support Skills, such as understanding learning styles; planning, organizing, and setting priorities; using educational resources and services; and accepting failure and success and learning from both (pp. 12-14).

- Information Management Skills, such as familiarity with library organization, knowledge of the categories into which information falls, ability to discriminate among sources of information, and computer literacy (pp. 14-18).

- Communication Skills (pp. 18-21)
  Reading; Writing; Listening and Taking Notes; Speaking.

- Analytical Skills (pp. 22-23)
  Intellectual Activities; Problem Solving.

Entry-Level Knowledge

- Humanities, Arts, and Foreign Languages (pp. 24-29)
  Language Arts; Visual and Performing Arts; Foreign Languages and Cultures.

- Natural Sciences, Mathematics, and Technical Studies (pp. 30-35)
  Basic Dimensions of Scientific, Mathematical, and Technological Understanding; Cultural and Personal Awareness of Disciplines; Crucial Knowledge Areas; The Context of Science; Mathematics Anxiety.

- Social Sciences and History (pp. 35-38)
  Interrelationships; Global Issues; Major Issues of Social Science Study of the United States; Social Science Methods; History Methods.

The Task Force urges academic alliances of school and college faculty to use these statements of knowledge and skills, and the rest of this Report, to reexamine the relationship between school curricula and college programs. Such a reexamination should help produce curricular redesign and reform at both levels, as well as smoother articulation between them.

Assessment

The Task Force strongly endorses "authentic" or "performance-based" assessment. Authentic assessment attempts to evaluate students by processes similar to those used to gauge accomplishment in the world beyond the classroom. Compared to traditional testing, it typically involves a more extended process of judgement by the teacher and more extensive products on which the student is to be evaluated. Rather than relying on the limited sampling of a student's knowledge and skills that can be realized through a short-duration standardized paper-and-pencil test, performance-based assessment can include recorded conversations in a foreign language, teaching observations, laboratory experiments, individual and group projects, responses to open-ended questions, exhibitions, interviews, and portfolios.

The Task Force recommends that high school students:

- beginning as early as the 9th or 10th grade, engage in a continuous authentic assessment experience that is maintained throughout their high school years; and

- create an assessment file that could be taken with them to college and used there for academic planning and advisement.

Completion of the assessment file could be part of a **High School Senior-Year College Preparatory Course**. The Task Force recommends the creation of such a course to prepare students for the differences between high school and college, and to serve as the capstone assessment course in which students and teachers select and analyze materials to be included in the assessment file the student will bring to college. In addition, this course would:

- teach time-management and stress-management skills; discuss goal-setting, brainstorming, teamwork, independent and collaborative group learning, and other dimensions of problem-solving strategies;
- enlighten students about college academic and personal support services and learning resources;
- promote effective study and learning techniques;
- orient students to the differences between the high school and college environments, and;
- introduce students to academic expectations in the various college majors.

Consistent with the principle that assessment should be timely and usable by students and schools as well as by the University, the Task Force recommends establishment of a **Mathematics Early Alert and Intervention Program**. Based on Ohio's highly successful Early College Mathematics Placement Testing Program, the program would offer high school juniors an assessment of their preparation in mathematics in terms of the requirements in their desired majors at a New York college or university of their choice. This information encourages juniors to take mathematics courses in their senior year that will allow them to move directly into appropriate college mathematics, science, engineering, and technical coursework without remediation. A joint request to fund the program has already been advanced in the 1993-94 budget proposals of SUNY, the City University of New York, and the State Education Department.

In addition to these recommendations on assessment, the Task Force suggests a number of changes in New York State Regents High School Curricula and Examinations, including:

- Regents courses, or other courses of equal or greater rigor, should be made available to all students who wish to take them, and as many students as possible should be encouraged to do so;

- serious consideration should be given to redesigning Regents courses and exams to include more authentic assessment;

- substantial amounts of writing should be required and assessed through local exams, portfolios, and projects in all grades, but especially in Regents high school courses;

- the Regents Global Studies Examination should address only 10th-grade learning in global studies; a new evaluation for 9th-grade global studies should be developed;

- in foreign languages, students should begin work on Checkpoint C of the *Modern Languages for Communications* New York State syllabus immediately upon completing Checkpoints A and B, usually after 10th grade;

- students intending to major in a science, engineering, or elementary education should complete four years of high school science, while all others should take a minimum of three;

- mathematics should be studied in every high school year, and the New York State Sequential Mathematics Courses I, II, and III should be re-examined and revised using the National Council of Mathematics Standards as a reference.

These recommendations and all others pertaining to assessment can be found on pp. 39-52 of the Report.

Enriched Choices and Accelerated Programs

Because the level of mastery of knowledge and skills required for an accelerated or enriched college degree program is a matter to be decided by the faculty on each campus, the Task Force focused its recommendations in this area on the provision of opportunities and challenges for better-prepared college entrants. On pp. 53-56 of the Report, the Task Force recommends nine ways SUNY can encourage students to enhance the quality and productivity of their collegiate experience. These include taking greater advantage of:

- appropriate course sequencing (non-duplication) between high school and college;

- course challenges;

- advanced placement credit;
- new course delivery technologies;
- early admission; and,
- honors programs.

Closing Statement

The recommendations contained in the Report are not admissions standards, nor are they a description of the preparation with which most students currently come to SUNY. Rather, they represent the University's attempt to state forthrightly the level of knowledge and skills it would like its incoming freshmen to have, in the interest of keeping their options for college study as open as possible. The University will now build upon the collaboration the Task Force has begun with school colleagues with the aim of lifting New York's entire educational enterprise to a higher plane.

PREFACE

> *A great public university is both accessible and academically excellent. A university that promotes access without excellence offers mere mediocrity and is unworthy of the public trust. One that aspires to excellence without concern for access denies to many people who support the university a fair and full measure of its benefits*
> (SUNY 2000: A Vision for the New Century, *p.5)*.

In 1991, the Board of Trustees and the Chancellor of State University defined a vision for SUNY at the beginning of the next century and adopted a series of goals and strategies to implement that vision. Their overriding principle was the unswerving commitment of the University to the maintenance of access and academic excellence. Perhaps nowhere does that commitment become more manifest than in the message the University sends to its prospective students: what may we in the University expect of them and what may they expect of us?

SUNY, along with the rest of American elementary, secondary, and higher education, is hearing a new urgency in the calls for higher standards for students at all levels. There is also growing public and political pressure for greater accountability and clearer statements of what we expect and what we, in turn, deliver. The work of this Task Force is one of several attempts currently under way in New York State to answer these calls and respond to these challenges. It focuses particularly upon the preparation needed for successful entry to and completion of the freshman year of study, for successful transition from pre-collegiate learning — whether in the high schools or the world of work — to college-level learning.

Now more than ever, institutions of higher education must articulate with more precision and clarity their expectations of students on entry to college. In order to promote excellence, these expectations should be framed in terms of high standards; and in order to maintain access, colleges should provide appropriate instructional opportunities and other academic support services for those individual students who can, with some developmental help, meet these expectations in a timely manner.

Moreover, colleges and universities must also articulate clear goals to mark different levels of accomplishment throughout the undergraduate experience. Students can succeed in gaining college entry and in progress toward their degrees only if the expectations for entry and for retention are clearly stated. In this context, defining entry-level skills for college students becomes the first set of learning outcomes in a larger scale assessment of student learning in higher education.

The entry-level knowledge and skills expected of beginning college and university students are obviously closely related to the learning outcomes desired for graduation from high school. Schools and colleges must be equal partners in any attempt to reform their students' preparation for a successful transition to collegiate work. Assessment of school-exit learning and college-entry learning must be a joint endeavor: in either iteration, the focus is on skills, capabilities, and broadly-defined knowledge areas with the ultimate goals of instructional improvement, enhanced learning, and public accountability.

The expectations of skills described in this Report of the SUNY Task Force on College Entry-Level Knowledge and Skills are expressed in the broadest terms. They are intended for any student entering any unit of the University, for non-Regents Diploma students as well as those pursuing a Regents Diploma. However, because the missions of individual campuses of SUNY vary, the level of mastery of skills and knowledge bases necessary for success will vary among campuses. The final arbiter of the specific expectations of a particular campus is, of course, the faculty; it is they who will provide the interpretations appropriate for the students they serve.

The following report is a description of the skills, abilities, and knowledge bases that students should bring to their freshman year of college in order to succeed in a wide variety of courses and new experiences. It should be emphasized that this description is neither an attempt to provide a complete contemporary definition of the skills in themselves nor an effort to direct any curriculum for the schools. Although the descriptions should not be read as narrowly prescriptive, they do represent the Task Force members' best thoughts on the simplest route toward success. Thus, for example, the references to Standard English in the Communication Skills section do not intend to privilege that mode of communication in a simplistic political sense; rather the intent is to describe the most usual means of communication in a college-level classroom. Further, the skills described are those required of entering students who can succeed in the college curriculum without need for further preparatory or developmental work.

In the preparation of this report, the SUNY Task Force on College Entry-Level Knowledge and Skills benefited tremendously from recent publications by task forces and committees that preceded us in addressing the issues of college and workforce preparation. A bibliography of the publications upon which the Task Force drew most heavily is provided at the end of the report.

Section 1
INTRODUCTION

Now that the student outcomes assessment movement is reaching the public schools, SUNY must lend its expertise in helping to determine what a high school graduate should know and be able to do and how to assess the graduate's level of mastery. This means becoming part of the incentive for students to stay in school and fulfill their academic potential rather than simply satisfy minimal standards
(SUNY 2000: A Vision for the New Century, *p. 49*).

1.1 Establishment of the Task Force and Charge

The idea for this Task Force sprang from a series of discussions State University Chancellor D. Bruce Johnstone and Provost Joseph Burke had in 1990-91 with New York State Commissioner of Education Thomas Sobol following the Commissioner's announcement of *A New Compact for Learning*, a major reform for public elementary and secondary education in New York State. The Task Force was created to formulate at least a part of SUNY's contribution to the *Compact's* call for higher and continuing education to:

- collaborate in specifying the skills, knowledge, and understanding which students in elementary, middle, and secondary schools need to acquire and in developing measures for assessing that acquisition.
- collaborate with schools to motivate and prepare elementary, middle, and secondary students for higher education:
    - explore the implications for college admission and placement of State and local assessment programs which certify students' performance at specified levels of proficiency. Define institutional (or systemwide) standards for preparation to begin college-level study, and communicate these standards to students, parents, schools, and the public; and
    - provide feedback in convenient ways to school districts on their graduates' academic performance in college.

(A New Compact for Learning, 1991, pp. 15-16)

In the summer of 1991, after seeking nominations from campus presidents across SUNY, the University Faculty Senate, and the Faculty Council of Community Colleges, Provost Joseph Burke appointed a task force of faculty, students, and professional staff. The Task Force members represent a range of disciplinary expertise and all types of SUNY campuses. Colleagues from the State Education Department and SUNY Central Staff were also invited to serve.

The first meeting of the Task Force took place from August 12-14, 1991 at Rensselaerville, New York. Commissioner Sobol, Chancellor Johnstone, and Provost Burke met with the group and placed the work of the Task Force in a State and national context. Commissioner Sobol spoke of his goals for the *New Compact for Learning*: to reassert high standards, to lift the whole enterprise even as he worked to narrow gaps, and to place the schools at the center of developing children's intellectual competence (see Appendix A). He also presented his plans for a new State Curriculum and Assessment Council and associated curriculum and assessment subject-matter committees.

In keeping with the State Education Department's direction, Chancellor Johnstone spoke on the confluence of SUNY agendas in this Task Force, including learning outcomes assessment, new learning technologies, and enhanced learning productivity. He charged the group to articulate expected standards of accomplishment in knowledge and skills. Rather than setting admissions standards, Dr. Johnstone directed the Task Force to go beyond minimum levels of competence and to identify a range of levels with which beginning students may embark upon collegiate study. These presentations were concluded with Provost Burke's comments on the important balance in SUNY between equality and quality. He directed the Task Force to be explicit about standards and skills, the goal of the Task Force being to help improve students' chances for success in college.

The charge to the Task Force was finalized as follows after further discussion:

The Charge to the Task Force

The State of New York is embarking upon a revolutionary reform of public elementary, middle, and secondary education in the 1990s. In April 1991, the Board of Regents adopted *A New Compact for Learning* that calls for definition of desired educational results in terms of specific learning outcomes and for new means of assessment that will guide activity and promote accountability. The State University of New York is committed to participation in and support of this comprehensive new approach.

The State University Task Force on College Entry-Level Knowledge and Skills is charged to advise the University on the content and level of learning that would assure beginning students a reasonable chance of successfully completing a freshman year of collegiate study in a baccalaureate or associate's degree program:

- What should a SUNY College or University entrant know and be able to do in order to be fully prepared for successful college-level work through the freshman year?

As indicated in *A New Compact for Learning*, "The Regents will state more specifically the skills, knowledge, and values students should acquire as a result of elementary and secondary education. It is no longer enough, for example, to require two years of mathematics at the high school level—the desired results of such study will be made explicit." The Task Force is asked to articulate college entry-level knowledge and skills with corresponding precision:

- What program of study and form of assessment will enable the University to determine that prospective students have accomplished these expectations for successful entry-level collegiate study?

In determining the appropriate form of assessment of entry-level knowledge and skills, the Task Force should not restrict its attention to minimum standards for entry to collegiate work. Students enter SUNY with wide ranges of preparation and the University must be prepared to challenge the most able and best prepared as effectively as it assists those with deficiencies to reach the expected entry-level standards:

- What levels of mastery of the entry-level knowledge and skills could help to identify students for advanced standing, special honors programs, accelerated associate and baccalaureate programs, and time-shortened joint baccalaureate and graduate or professional programs?

1.2 State and National Context

The work of the SUNY Task Force must be placed in the context of the current State and national discussions on assessment, national standards, and college entry-level skills. The call for assessment of student learning outcomes gained tremendous national attention in the early 1980s; however, interest in and concern about outcomes as a means for institutional accountability and instructional improvement have been part of higher education dialogue since the early 1970s. Reports by the National Institute of Education's Study Group on the Conditions of Excellence in American Higher Education (1984) and the Association of American Colleges' Project on Redefining the Meaning and Purpose of Baccalaureate Degrees (1985) brought the vocabulary to the fore. By 1987, an American Council on Education survey of colleges and universities in all 50 states revealed that 27% of respondents reported a state assessment mandate and 80% reported expecting such a mandate in the next several years. It was at this point in history that SUNY developed its systemwide interest in student learning outcomes assessment.

In December 1988, Provost Burke called for SUNY campuses to develop comprehensive assessment plans which addressed four elements of undergraduate education: communication and computation, general education, academic majors, and students' social and personal development. In June 1989, campuses submitted for review by a SUNY-Wide Assessment Committee (chaired by Provost Burke) inventories of assessment data that were already available on campus and in June 1990, their Comprehensive Plans were filed. The first annual Progress Reports from each campus were completed by November 1991.

While assessing college student learning, it became clear that one of the important variables in student success was preparation for college study. Therefore, the calls for explicit standards for college entrance can partially be explained as a result of the earlier interest in assessment of learning outcomes in higher education. In addition, however, the interest in college entry-level skills is also the result of the national K-12 educational reform movement that has been gaining momentum for almost a decade since publication of *A Nation at Risk* (Commission on Excellence in Education, 1983).

The effort to provide a seamless transition of educational development from entry into nursery school to attainment of higher education degrees has led the two major public systems of higher education in the State of New York to establish task forces and committees to draft reports on entry-level skills for freshmen entering their campuses. The CUNY system began its meetings in the spring 1991 and the SUNY system in the summer of 1991. The SUNY Task Force was able to maintain close communication with the CUNY committees and learn from their excellent reports, keeping in mind CUNY's unique relationship and responsibilities with the New York City schools and Board of Education. These projects were highlighted in Governor Mario M. Cuomo's 1992 State of the State message:

> Both SUNY and the City University of New York (CUNY) have launched projects along with the public schools to detail skill and knowledge requirements for high school graduates seeking admission to their campuses. Once implemented, these initiatives should reduce the need for remediation and improve the retention of students at the two Universities. *(Message to the Legislature, January 8, 1992)*

Another feature of the current landscape concerning skills assessment is the notion of national standards, which in its broadest definition was introduced as an important term in the education debate by the report on *America's Choice: High Skills or Low Wages* (Commission on the Skills of the American Workforce, 1990) and by the *America 2000* report (U.S. Department of Education, 1991). The SED Curriculum and Assessment Council has been examining the idea of a national system of exams proposed by the New Standards Project which involves 16 states, including New York, and six major urban school districts. Two members of the SUNY Task Force, Frank Ambrosie and Richard Jarvis, also serve on this Curriculum and Assessment Council.

The national standards debate has also spurred projects concerned with the development of skills needed for success in the work force. SUNY has participated in several New York State initiatives to define work force skills. For example, SUNY joined with the Department of Economic Development in the Strategic Training Partnership for Industrial Modernization. The Governor, the Lieutenant Governor, and the State Education Department took the lead in a Task Force on *Creating Career Pathways for New York State Youth*, with representation from SUNY, the Jobs Training Partnership Council, and New York State United Teachers. This latter Task Force appears to have followed quite closely the directions outlined in *America's Choice* in addressing the issue of world-class standards of workers' skills for a competitive economy and in the kinds of reforms proposed for secondary education.

Assessment of learning outcomes and specification of desired standards at particular grade levels have increasingly engaged the national disciplinary associations in the last few years. Activity has been particularly intense and fruitful in mathematics and the Task Force was able to draw much of value from the work of the National Council of Teachers of Mathematics.

The SUNY Task Force on College Entry-Level Knowledge and Skills has benefited from knowledge of and relationships with these other committees on standards and assessment. Consequently, this report is presented as part of an array of national and state movements, all trying to answer questions of preparing students as contributing members of society.

1.3 Task Force Approach and Principles

At its first meeting, the Task Force refined and finalized its charge and then determined a two-stage strategy for tackling the first element of the charge: first identify the skills needed for successful transition through the freshman year; and then move on to elaboration of a desired knowledge base. Three subcommittees were formed to develop recommendations for communication skills, analytical skills, and academic and personal support skills. It was immediately apparent there would be considerable overlap and interaction among the three categories.

The Task Force met again on October 11-12, 1991 in Albany and approved the draft reports of the three skills subcommittees (see Section 2). It proved quite difficult to effect the transition from skills to knowledge areas. Rather than attempt to produce a list of desired "facts," the group struggled with the distinction between skills and knowledge areas, concluding that the ideal towards which we would strive would be to articulate knowledge areas as a form of "higher order" skills. Three knowledge area subcommittees were formed: humanities, arts, and foreign languages; natural sciences, mathematics, and technology; and social sciences and history.

The recommendations from the knowledge area subcommittee reports were discussed and revised at the third Task Force meeting on January 17-18, 1992 in Albany (see Section 3). This concluded our attempt to address the first element of our charge and it was decided to seek additional consultation and feedback on our work from our University and school colleagues while we proceeded to consider the issues involved in assessing these skills and knowledge. A representative from The College Board briefed the group on the new Pacesetter program currently under development for eleventh and twelfth grade curricular reform and assessment.

The fourth meeting of the Task Force took place on March 20-21, 1992 in Albany and focused entirely upon approaches to assessment. The group heard presentations on nationally normed achievement testing by American College Testing, on New York State's Regents Examinations and Competency Tests, on the College Preparatory Initiative currently underway in the City University of New York, and on an Early Mathematics Placement Testing program in Ohio. Other means of assessment, such as portfolios, were also discussed.

Meanwhile, the initial recommendations on entry-level skills and knowledge had been compiled in a draft Preliminary Report, dated February 26, 1992, that was released to the University and secondary school communities. Consultation with the University followed two primary paths: one through the faculty governance organizations, the University Faculty Senate and the Faculty Council of Community Colleges; and the other through the chief academic officers of each of SUNY's 64 campuses. Presentations were made at meetings of each group and copies of the draft report distributed to all senators, councilors, and academic vice presidents.

Consultation with the schools was necessarily more complex and opportunistic. From the beginning of the exercise, Task Force members had consulted individually with local high school teacher colleagues. However, it was decided that formal meetings with groups of teachers or representatives of teachers' associations would be delayed until a first draft of at least the first part of our report was available for discussion. We needed to clarify our own thinking and our own expectations as university faculty; but, at the same time, the Task Force was fully aware that in order for our recommendations to be practical, feasible, and supported, these suggestions must eventually become the product of a cooperative endeavor. In short, for our report to be effective, it must be as the result of a joint venture in school-college collaboration.

The draft Preliminary Report (February 26, 1992 version) was distributed widely through the State Education Department Staff and Curriculum Development Network (SCDN), the New York State Council of Educational Associations (NYSCEA), and the New York State Curriculum and Assessment Council. Presentations were made at the Otsego-Northern Catskills BOCES Superintendents' Conference in March, and at both the Central New York Education Consortium and NYSCEA meetings in April. From contacts made through all of these groups as well as individual nominations, a representative sample of teachers, superintendents, counselors and principals from different kinds of schools around the state was invited to our fifth meeting on June 4-6, 1992 in Albany.

Discussions at the June meeting focussed upon the expectations for skills and knowledge areas presented in Sections 2 and 3. By this time we had also accumulated additional reactions from the campuses and various school communities who had received a copy of the Preliminary Report. An additional subsection on information management skills was drafted and shared with members of the SUNY Librarians Association at their annual summer meeting.

The sixth meeting of the Task Force on August 21-22, 1992 in Albany again included colleagues from the schools. This session was directed to two chief activities: discussion and revision of a draft Section 4 on Assessment, and development of a draft Section 5 on Enriched Choices and Accelerated Programs. The Superintendent of the Ithaca City School District and the Principal of Ithaca's Alternative Community School explained that school's approach to alternative education and authentic assessment at the middle and high school levels. After this meeting, a version of the draft report including all five sections (dated September 29, 1992) was commented upon by the Task Force and our colleagues from the schools. Based on these comments, a final draft was prepared and submitted to the Chancellor and the Provost.

Several important principles have guided the discussions of the Task Force from the initial meeting:

Task Force Principles

1. Recommendations should serve to expand choices for students, not limit them. At the same time, the Task Force should strive to articulate a preparatory base which would help students avoid limiting their own choices before they arrive on a SUNY campus.

2. In order for our work to encourage students from all backgrounds and communities in New York State, the language of our text and recommendations should avoid even subtle or unintentional forms of racial, ethnic, gender, or other stereotyping.

3. The work of the Task Force must be presented in such a way that it can communicate to students and parents the collegiate consequences for better academic preparation (broadly conceived) in the pre-college years. The Task Force's work will be of ultimate value only if it helps to change students' behaviors and enrich their learning.

4. Dialogue with the campuses, especially when specifying skills levels, will be essential. Campuses will need to identify the profile of their students against the skills identified by the Task Force and the levels of mastery they would expect of their students.

5. The description of skills and knowledge areas should be understood as reference points and not as admission standards. Early on, the Task Force chose as a reference point those students who are entering or who are planning soon to enter collegiate programs and those students who will be able to complete that first year with few academic obstacles and no need for additional preparatory or developmental work.

6. There will be students admitted to SUNY institutions without meeting these reference points and those students should be afforded the necessary developmental programs and support services.

7. Single standardized test scores cannot capture the range of knowledge and skills necessary for success in the freshman year.

8. The Task Force approach to the schools is one of colleagues engaged in an endeavor of mutual interest and, it is hoped, benefit. Linkages in the form of genuine collaboration between high school and higher education colleagues need to be continually encouraged.

A significant number of high school students may be unclear about whether they intend to go to college. These recommendations of the Task Force, therefore, urge all students to develop abilities and choose high school courses that preserve their options for later college success. Many students change their career plans and academic goals, many leave and return to college with different goals, and, as a result, our recommendations should inform them of the academic preparation that would support their widest range of future choices. Further, our interpretation of "full preparation" in reference to the skills differs somewhat from that in knowledge areas. Insofar as every high school graduate may eventually wish or need to pursue some form of postsecondary education, we consider the skills described herein to be worthy objectives of everyone who receives a high school diploma. The knowledge area recommendations more particularly pertain to college-bound students who plan to enter programs with a general education component.

In keeping with the *New Compact for Learning*, the Task Force Report encourages students to keep an open mind and expand their choices. Thus, we recommend not an unrealistic universal mastery but rather the broad and deep appreciation of what has been referred to as "higher order" skills in the various major groupings of the liberal arts and sciences. These skills are necessary for students who may face general education requirements; who want a context for making informed choices among colleges and careers; and who wish preparation to enable them to continue to function at the highest level as family members, consumers, spectators of the human condition, and citizens effectively engaged in contributing to their society.

Section 2

ENTRY-LEVEL SKILLS

Recommended entry-level skills are intended to provide each student with tools not only to secure success, but also to ensure that the widest possible range of college opportunities is available. These skills should be reenforced in all classes and throughout every year of the school experience; however, they should be particularly emphasized during the student's senior year in high school or in the orientation of returning students immediately before matriculation into the freshman year of college. In addition to the specifically described skills below, an implied but essential skill for success at college is the ability to integrate skills and knowledge areas.

2.1 Academic and Personal Support Skills

In order to succeed in college, students need to demonstrate certain study and personal support skills. These skills include the following abilities.

1. A student should have experience in planning, organizing, setting priorities, and using time management skills.
2. A student should be effective at listening, communicating, and note-taking.
3. A student should become more effective at studying and learning by understanding different learning styles, particularly the student's own.
4. A student should become knowledgeable about finding and using services available at an institution and fully using the available educational resources.
5. A student should be able to accept failure and success and learn from them both.
6. A student should have experience in developing and maintaining high levels of self-esteem and self-challenge.
7. A student should have experience in developing such characteristics as task-setting, curiosity, and the desire for lifelong learning.
8. A student should have experience in the prolonged effort and practice needed in order to master complex materials and concepts and to solve problems requiring the integration of several concepts and skills.
9. A student should have experience completing homework assignments starting in the earliest grades of elementary school. These assignments should increase in complexity and duration as the student moves from elementary to middle to high school. Every student considering college needs to understand that learning acquired through study outside the classroom is at least as important to college success as class participation.

10. A student should recognize the relationship of fitness and wellness to academic success.

11. A student should have experience in cooperative as well as independent approaches to study.

12. A student should have experience in problem-solving and decision-making skills for independent living. Such experiences will vary widely, but should be such as to enhance the college student's success in learning in an environment less structured than that of the typical high school.

13. A student should have the opportunity to appreciate and profit from diversity and pluralism. This should include both a cognitive and a personal development goal. The appreciation should be for cultures different from the student's own culture, for the student's own culture, and for the value of inter-cultural, inter-ethnic, and international communication.

14. A student should have experience in acknowledging and promoting values and ethics. The student should be encouraged to develop sympathy and action-oriented concern for others, a regard for humanity as a whole. The student should be given an opportunity to develop the values and ethics of voluntarism and to develop an appreciation for the notion of a harmonious and inclusive community.

15. A student should have an opportunity to gain an appreciation of the processes of a participatory democracy.

Recognizing the importance of a smooth transition between high school and college, the Task Force recommends that all students pursue an academically challenging senior year.

In keeping with these broad goals, the Task Force strongly recommends the development and implementation of a **High School Senior-Year College Preparatory Course**. This course should be developed by both high school and college faculty. It should serve to challenge students. The Task Force emphasizes the centrality of the High School Senior-Year College Preparatory Course and further recommends that the State University of New York in conjunction with the State Education Department appoint a working group to define the content, structure, delivery, and assessment of this program. The group should include representation from the New York State School Counselor Association and the New York State Council of Educational Associations, along with University and Department staff.

The Task Force also recognizes that ideally the expectation for entering college should be established no later than the first year in high school. To that end, college planning and programming for both students and parents should occur in the ninth grade or earlier and involve college faculty and staff.

2.2 Information Management Skills

A. Computer Literacy

In order to make the most effective use of computational tools, students need to know the basic terminology appropriate to the use of computers, need to be able to enter specific commands and data into computer applications, and need to understand the context in which such tools are used, including the way in which the tool aids the problem-solving process and the limitations of the tool. Students should understand the entire computer-aided problem-solving task from specification of the problem through analysis of the result.

In computer applications, students should be able to recognize that the tool will help solve a problem. They should also be able to construct a solution to a problem as well as be able to test the solution for correctness and reasonableness.

In selecting software for a given task, students should be able to make effective use of computerized data manipulation tools such as word processors, outliners, spreadsheets, and databases. If students have had adequate experience with a variety of applications, they are not intimidated by learning new ones. This experience with computers should be mirrored in experience with other kinds of technological aids such as calculators.

B. Information Literacy

> To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information. . . . Ultimately, information literate people are those who have learned how to learn. They know how to learn because they know how knowledge is organized, how to find information, and how to use information in such a way that others can learn from them. . . . Information literacy, therefore, is a means of personal empowerment. *(American Library Association, 1989)*

The preceding definition is quoted from the final report of the American Library Association Presidential Committee on Information Literacy. The Task Force supports the conclusions of the ALA committee, and much of the following two subsections is taken directly from their report. Moreover, the Task Force recommends that teacher education and library school curricula incorporate strong information literacy components, so that all school teachers and librarians will be able to integrate information skills into their courses and other work with pupils.

B.1 Public Education vs. "The Information Elite"

The ALA quotation is a worthy statement of the individual's and society's goals of education in any age. There is nothing new about the goal of an informed citizenry accustomed to and proficient at seeking information. What is profoundly different today is the continuing acceleration of the information "explosion" and the continuing development of new technologies to manage that volume of data. In this context the ALA's notion of information literacy as "personal empowerment" and the specter of an "information elite" both seem amply justified.

As with so many of the Task Force recommendations, and in the belief that any form of "two-tiered society" must be avoided, we advocate the goal of information literacy for all high school graduates, not merely those with imminent plans to attend college. Such new technological tools as we reference here reinforce the need to understand the variety of individual learning styles and learning abilities. As the ALA report recommends, "New knowledge from cognitive research on thinking skills should be incorporated into pedagogical skills development." Our institutions of higher education should become more sensitive to the varieties of learning styles and in order to enhance this goal, institutions of higher education should be in the forefront of the continuing development of software to assist differently-abled populations to succeed in the college environment.

B.2 "An Information Age School"

The ALA paper notes:

> . . . most current educational and communication endeavors—with their long-standing history of prepackaging information—militate against the development of even an awareness of the need to master information management skills. The effects of such prepackaging of information are most obvious in the school and academic settings. Students, for example, receive predigested information from lectures and textbooks, and little in their environment fosters active thinking or problem solving. What problem solving does occur is within artificially constructed and limited information environments that allow for single "correct" answers. *(American Library Association, 1989)*

In contrast to this present circumstance, the ALA report describes "An Information Age School" in the following manner:

> the school would be more interactive, because students, pursuing questions of personal interest, would be interacting with other students, with teachers, with a vast array of information resources, and the community at large to a far greater extent. . . . One would expect to find every student engaged in at least one open-ended, long-term quest for an answer to a serious social, scientific, aesthetic, or political problem. Students' quests would involve not only searching print, electronic and video data, but also interviewing people inside and outside of school. *(American Library Association, 1989)*

Ironically, this description of an information age school is not some "high-tech" vision, nor is it a call for some new breed of teachers. Rather, it is a modest description of what education at its best has always been. The demands and opportunities of the information age do not force a new role on grade school, high school, and college teachers. Perhaps with an additional assist from the new technologies effectively and appropriately employed, they enable us to do more of what we have always done best and enjoyed most.

B.3 Sources of Information and Related Skills

The following points are quoted from "Preparation High School or What Students Should Know About Libraries When They Leave High School," by Carmelle Knudsen and Johnette Orpinela (*Emergency Librarian*, May-June, 1992):

> **Familiarity with libraries:** Know the services one can expect and how they are located: librarians, reference sections, periodicals, catalogs, indexes, maps, government publications, on-line searching.
>
> **Search strategy:** Know the categories into which information falls: dictionaries, government publications, maps, encyclopedias, ephemeral materials, books, periodicals, computer databases. Know how to organize a search, and be able to use materials efficiently and effectively, with note-taking and note-making skills.
>
> **Basic skills:** Know how to find information through indexes and catalogs (card or on-line) by the use of subject search, title search, author search, boolean search. Know how to use the information given: call number, tracings, etc. Know the differences between catalogs, indexes, and tables of contents and the appropriate use of each.
>
> **Awareness of variety:** Know that there are many periodical indexes (some of which are quite specialized), that all subject areas have reference books, and that databases have many sources and resources.
>
> **Analysis of materials:** Know how to evaluate the "found" material for appropriateness, authority, timeliness, bias.

The State University of New York Librarians Association describes the most fundamental information skills and knowledge bases as follows:

- A student should have experience in identifying and analyzing many different types of information needs from diverse subject areas.

- A student should recognize the difference in the information provided by different types of information sources (books, magazines, newspapers, videorecordings, television, etc.).

- A student should be able to plan a logical sequence of steps (search strategy) to solve an information problem.

- A student should have experience using a variety of print and non-print information tools from which to gather information relevant to the information need.

- A student should be able to use a system of library organization to locate materials.

C. Implications of Technology: "Knowing" vs. "Knowing About"

Even if we accept the argument that the average college student today needs substantially less education in computer languages, calculus, finer nuances of language and the retention of immediately usable facts in a given discipline than did the student of a decade ago, this would not be true for students who wish to become programmers, physicists, poets and professors in the disciplines. The recurring theme in this report that students should seek to extend their options, not limit them, pertains to computer and information literacy as well as to other skills. Knowing and doing some of the sorts of things required of a programmer, scientist, poet, teacher, musician, artist, or linguist will serve to keep those options open. Perhaps more to the point, without such effort students cannot effectively judge whether such careers or avocations are viable or desirable options for them.

Finally, whether viewed as benefiting the individual or society, a good education is one which helps the student appreciate the richness of options and opportunities and enables the student to appreciate the satisfactions of knowing, doing, achieving, and accomplishing. A passive dependency upon new technologies will be no more satisfying than passive memorization, rote responses, or repetitive practice of a process on a set of artificial problems.

Therefore, the Task Force hopes that neither the Section on Computer Literacy nor the one on Information Literacy will be misconstrued. Optimally, students entering SUNY will have had practice, as well as theory, in the acquisition of both knowledge and skills, and will have come to enjoy such activities and accomplishments.

2.3 Communication Skills

Successful communication involves active rather than passive skills: creation of meaning and alert critical thinking are essential in all successful reading, writing, listening, and speaking. This active rather than passive quality entails the development of an interest and a willingness to engage in reading, writing, and speaking. Rather than provide a separate description of critical thinking in language arts, this report speaks to these fundamental abilities through a series of questions and statements used to define the various communication skills. The following questions require analysis, judgement, self-awareness, recognition of bias, attention to rhetoric, and openness to multiple meanings.

A. Reading

Although this description of reading skills refers to readings assigned in class, students are urged to read widely beyond what is assigned for their high school classes. It is generally agreed that people who have done so are more successful in college. Entering students should be able to read Standard English prose of the kind typically found in newspaper editorials and in current freshman textbooks in the arts, humanities, and natural and social sciences. They should also be able to read fiction, drama, and poetry reflecting different cultural perspectives, of the kind commonly found in anthologies for freshman English courses. Students able to read such materials should also be able to answer the following questions about a given work, or those of the following questions that are relevant to the work. The answers to these questions are not ends in themselves, but rather should serve as the basis for enhanced interpretation, understanding, and reflection.

1. What is the main idea, hypothesis, or task with which the passage or text deals? What are its plot, characters, and setting?
2. What are the important details or arguments that the author has used to explain or develop the main idea or hypothesis? How are incidents or images used to explain the theme, main idea, or hypothesis?

3. What are the meanings of the important terms or concepts as they are used in the context of this piece? What does a given term seem to mean in this text? Can it be interpreted differently by other readers?

4. Based on interpretation of the text, which assertions are based on a) facts, b) opinions, c) unsupported or irrelevant assertions? The student must be able to justify his/her responses.

5. Which statements or passages in the text contain language that is figurative, ironic, or rhetorical and what are some possible interpretations of selected examples?

6. What is the relation of a given graph, chart, or picture to the written text?

7. The student should be able to discuss the author's perspective or attitude toward the subject about which she or he is writing. How can the author's assumptions be interpreted or explained? Has he/she omitted information or issues that should have been included?

8. What is the significance of a given point? The student should be able to explain that significance.

9. The student should be able to discuss whether or not he or she agrees with the author's contention and should be able to provide reasons for or against such a position.

10. What is the organizational pattern of the text? What is the general structure of the argument? In other words, how is it organized? Do the sub-headings and summaries provide helpful information in understanding the organization of ideas in this text?

11. What portions of the text deserve special study? Why?

12. What, if any, are the reasons the text is difficult to read?

13. The student should be able to discuss the ways in which this text or argument differs from another with similar content with which the student is familiar. What parallels exist between this text and readings in other courses?

14. In what ways do diction, sentence construction and length, formality, use of imagery, and the like characterize the style of a given work?

15. Why does this text matter beyond the demands of the course in which it was assigned? In what other contexts would the student find the material covered in this text helpful and meaningful?

16. What are the author's purpose and intended audience as evidenced by writing style and word choice?

B. Writing

Teachers of all disciplines are urged to require substantial writing in their courses and to evaluate that writing by the same standards across a given grade level. Students should engage in writing as a primary method of learning and form of expression and should have some experience using computers to support their basic writing activities. In particular, every English course should regularly require the writing, editing, and rewriting of papers of varying lengths. By the time students enter college, they should be able to write Standard English prose in extended papers of between 800 and 1,000 words, and to that end would have the following abilities.

1. Students should be able to conceive and articulate ideas about a topic in order to write for a given purpose and for a particular audience.
2. Students should be able to gather and evaluate information from primary and secondary sources appropriate to the topic, to use this information in an original report or research paper, to quote, paraphrase, and summarize accurately, and to cite sources properly.
3. Students should be able to organize, select, and relate ideas to a central focus, and, through pre-writing and drafting, to develop them in coherent paragraphs.
4. Students should be able to distinguish colloquial from formal style and demonstrate control of each.
5. Students should view writing as a process, and hence be able to improve their own writing by restructuring, correcting errors, and rewriting. This ability should include editing skills that allow the writer to critique constructively his or her own writing as well as that of others.
6. Students should be able to write Standard English sentences with attention to sentence structure, verb forms, punctuation, capitalization, possessives, plural forms, and other matters of mechanics, word choice, and spelling.

C. Listening and Taking Notes

Entering students should be able to listen to an oral exposition of scheduled class length in Standard English, and to listen to (and participate in) a class discussion. They should be willing to understand and accept different speaking styles and the various accents of English that reflect cultural, regional, or national differences in speech. Students should be able to take accurate notes. These notes should be sufficiently detailed for effective studying. In addition, students should become proficient in different note-taking techniques appropriate to different learning styles and different material. Students should also be able to understand orally delivered assignments, answering and formulating questions such as "what are you supposed to do?" and "what do you not understand about the assignment?" Students who are able to listen to expositions and discussions can answer the following questions about what they have heard.

1. What were the main points? What was being compared or contrasted? How can the relevant information be summarized?
2. What were the important terms?
3. What were some of the speaker's examples (as opposed to points, generalizations, hypotheses, or principles)? Were the examples relevant to the main point(s)? Did they provide factual support or emotional appeal?
4. If a portion of the lecture is not understood, can the student formulate a question which focuses on the difficulty?
5. What was the organization of ideas or topics? Why did a certain topic or idea follow another? What were the main verbal or nonverbal clues as to what to expect (e.g., "There are four. . .") or as to what is important?
6. What are the speaker's purpose and intended audience?
7. What techniques did this speaker use to achieve the purpose and reach the audience? Were they successful? Why or why not?

D. Speaking

Students entering college should be adept at the following oral skills:

1. the ability to answer and ask questions coherently and concisely in Standard English;
2. the ability to summarize their own views on a given topic clearly and concisely;
3. the ability to participate in small-group discussion in a way that contributes to furthering the group's goals;
4. the ability to refine their ideas through dialogue with others.

2.4 Analytical Skills

Analytical power requires that students be able to discern relations, reason logically, and use a broad spectrum of mathematical methods to solve a wide variety of problems. Since the ability to use numbers is as important as the ability to use words, the student should appreciate the logical approach inherent in mathematical and scientific processes. Students should be taught to seek solutions, not just memorize procedures; explore patterns, not just learn formulae; and formulate conjectures, not just complete exercises.

A. Intellectual Activities

The Task Force recommends that entering students should be able to perform the following kinds of intellectual activities, as described in *Everybody Counts: A Report to the Nation on the Future of Mathematics Education* (National Research Council, 1989). The level of performance for each of these skills is suggested by the examples included in Appendix B.

1. The student should be able to perform mental calculations and make estimates with proficiency, deciding when an exact answer is needed and when an estimate is more appropriate.
2. The student should know which mathematical operations are appropriate in particular contexts.
3. The student should be able to use a calculator and computer correctly, confidently, and appropriately.
4. The student should be able to estimate orders of magnitude to confirm mental or calculator results.
5. The student should be able to use tables, graphs, spreadsheets, and statistical techniques to organize, interpret, and present numerical information.
6. The student should be able to select and use computer software appropriate for the given task.
7. The student should be able to formulate specific questions from descriptions that do not contain clearly defined problems.
8. The student should be able to select or devise effective problem-solving strategies, algorithmic or otherwise.
9. The student should be able to develop the ability to devise controlled procedures to collect data and to develop an hypothesis from the data or use the data to test a given hypothesis. It is important that the student not be taught "cookbook" procedures throughout but

that the student understand the nature of the equipment and procedures used in data gathering.

10. Students should be able to distinguish between fact and opinion, between a statement and an argument supporting a statement. They should be able to recognize an argument in ordinary English and identify the basic structure of the argument. They should understand the relationship between factual truth and logical correctness.

11. The student should be able to identify and avoid the common errors in reasoning, derive consequences from given information where that information is presented in a variety of contexts and styles, and identify assumptions not explicitly stated.

B. Problem Solving

Problem-solving ability is so crucial to success in all college disciplines that the following should be taught as the components of the process. After reading the statement which contains the implicit problem, the student should be able to answer the following questions.

1. What is the problem?
2. What is the known information bearing on the problem?
3. What is the question to be answered?
4. In addition to information explicitly provided, does a solution to the problem require assumptions?
5. How can the problem be reformulated using mathematical and logical terms?
6. What are some approaches and procedures for solving the problem?
7. What is a solution to the problem and the interpretation of the results? The student should be able to explain and communicate the results.
8. Are there other solutions to the problem? If so, the student should be able to explain why one solution or method was chosen over others.

The student should be able to solve both problems in which the techniques and procedures are given and those in which the techniques and procedures must be devised by the student. Students should be familiar with collaborative problem solving strategies as well as with those strategies better suited to individual work.

Section 3

ENTRY-LEVEL KNOWLEDGE

Our recommendations on what a student entering the university should know are presented in three broad knowledge area categories: Humanities, Arts, and Foreign Languages; Natural Sciences, Mathematics, and Technical Studies; and Social Sciences and History. Across these categories, the student should be encouraged to recognize and appreciate relationships between disciplines and between bodies and types of knowledge and learning. Interdisciplinary and multidisciplinary study should be an important goal throughout the high school and the college curriculum.

In addition, sometimes specific educational issues are highlighted because Task Force members perceived these problems as important in themselves and as exemplars of larger problems. For instance, math anxiety has tremendous negative impact on the wide range of a student's educational success. Other types of discipline anxiety can be observed in certain students' resistance to and fear of the study of foreign languages and of the arts. Our emphasis on math anxiety in no way implies a downplaying of these additional educational obstacles. However, research has shown the critical role of high school mathematics "gatekeeper courses" — the courses whose absences contribute most significantly to the weakened prospects of disadvantaged students (Pelavin and Kane, 1990). By undermining participation and performance in these courses, math anxiety may lead to adverse impacts that extend beyond just further study in mathematics itself.

In describing the levels of knowledge below, the Task Force has often provided examples in an effort to clarify the text. These examples are illustrations and are provided in no implied order of importance.

3.1 Humanities, Arts, and Foreign Languages

A. Language Arts

Since the study of English is a continuous spiral, and since English is not taught in a statewide sequential curriculum, the Task Force felt it was necessary to specify the level of sophistication and complexity of the language arts skills that should enable a freshman to succeed in college.

Each high school course should provide students the opportunity to achieve the skills in reading, writing, listening, taking notes, speaking, gathering information, and using computers outlined in Section 2 of this report. English courses should provide the most intensive training but they do not bear the sole responsibility.

Students should be able to read substantial and significant literature, including poetry, drama, fiction, and expository prose, from different periods and different cultures in the original English or in good translations. They should be able to read and to respond to works of a variety of lengths and complexities (that is, be able to answer the kinds of questions listed under Communication Skills, Section 2.3), understand a literary work as a product of a particular historical and social context as well as an expression of the creative, inquiring, aspiring human spirit. They should be able to engage in formal and informal writing in response to reading and observations.

We do not prescribe a reading list. By limiting our selection of examples, we intend to suggest only the difficulty and the variety of the readings that should be experienced. Furthermore, we do not mean to imply a student should master such texts but rather should have exposure to such texts and gain initial understanding. Early exposure to such texts is beneficial. By "substantial and significant literature ... from different periods and cultures" is meant works such as the following, selected as diverse examples of the level of complexity desired: Sophocles, *Antigone*; Shakespeare, *Romeo and Juliet*; a selection of classical haiku; The Declaration of Independence; Emily Dickinson, "A narrow fellow in the grass"; Chinua Achebe, *Things Fall Apart*; Martin Luther King, Jr., *Letter from the Birmingham Jail*; Alice Walker, "Everyday Use"; Isabelle Allende, *Eva Luna*; Mark Mathabane, Kaffir Boy; and Louise Erdrich, *Tracks*.

B. Visual and Performing Arts

The study of the arts is essential to a student's education and to lifelong learning. This study can enrich the student's quality of life whether the study of the arts is a preparation for a major in an arts discipline, the development of an artistic activity as a vocation, or the enhancement of the student's appreciation of the arts. In the College Board's *Academic Preparation for College* (1983), art study is broadly defined: "The actual practice of the arts can engage the imagination, foster flexible ways of thinking, develop disciplined effort, and build self-confidence. Appreciation of the arts is integral to the understanding of other cultures sought in the study of history, foreign language and social sciences." Study of the visual and performing arts introduces the student to major artistic achievements, the variety of forms of creative expression, the way art can sway public opinion, and the relationship between works of art and the diverse cultures and historical periods in which they were produced.

Entering college freshmen should have had early exposure to and opportunities to learn about different art forms, including the visual arts, theater, music, dance, film and video. This knowledge and experience will enable the student to develop and to demonstrate the following competencies and skills:

1. The student should be able to explore original and imaginative solutions to given problems. Examples of such a skill might include, but not be limited to, the design of an architectural project, or the creation of a painting or a piece of sculpture using restricted resources or materials.

2. The student should be able to use one or more art forms as vehicles for personal, social, and cultural expression; that is, the student should be able to express effectively feelings and ideas in painting, drawing, sculpture, theater, music, dance, film, or other media. Examples of such a skill might include, but not be limited to, the creation of a painting, drawing, piece of sculpture, architectural project, poster design, greeting card design, piece of jewelry, dance, or musical or theatrical work.

3. The student should have knowledge and understanding of art as a form of expression of diverse cultures and a wide range of historical periods. Examples of such understanding and appreciation might include, but not be limited to, study of Prehistoric, Egyptian, Classical, Medieval, Renaissance, Baroque, Impressionist, Native American, African-American, African, Pre-Columbian, Latino, Asian, and Islamic art forms as reflections of their societies.

4. The student should be able to compare, contrast, and describe orally and in writing the content and form, methods, techniques, and processes of a work of art in various mediums, using appropriate vocabulary.

5. The student should be able to demonstrate the abilities of observation, concentration, listening, critical appraisal, and reflection.

In order to indicate the skill and knowledge areas described in 3, 4, and 5 above, students should be able to ask and answer these questions in the evaluation of a given work (see Wilkins and Schultz, 1990):

a) Are feelings or emotions expressed or portrayed in the work? If so, what are they and in what way?

b) Does the work reflect the individual style of the artist? If so, what are the ways in which this was accomplished?

c) What are the material, medium, and technique used in the composition? How are these important to the work?

d) Was the work of art made for a specific purpose or a specific location? If so, what is it?

e) What is the content or meaning of the work?

f) Does the work express ideas, beliefs, and attitudes? If so, what are they?

g) Does the work reflect the culture or express the known artistic tradition, style, or period to which it belongs? If so, how?

h) How do the stylistic features between comparable works compare and/or contrast?

i) In what ways do the elements of the work as arranged or composed give it aesthetic impact?

C. Foreign Languages and Cultures

As the world becomes increasingly interdependent, the Task Force recognizes the growing importance of the ability to communicate well in a second language. Unfortunately, foreign language instruction in the United States is woefully inadequate to meet these needs. For instance, while it is well known that natural language acquisition most easily occurs before the middle-school years, programs in the United States are generally concentrated in the later years of adolescence and often limited to one or two years of study at the high school level. The widespread lack of highly defined entrance and/or graduation requirements in postsecondary education discourages serious study at the high school level or continued study in college or university.

If foreign language study cannot begin in the elementary grades, then at least it should be a continuum beginning in middle school and developed further in high school and college. Disrupting this sequence weakens the learning process significantly. On the other hand, a well articulated sequence could allow a large number of young Americans to reach language proficiency in at least one foreign language, a goal so far unattained in this country. The Task Force does not in any way wish to rule out the study of additional languages. Rather, we suggest a goal that is reasonble although admittedly not equal to the foreign language standards of other industrial nations (6-8 years of study of one or several languages). In order to encourage sophisticated second language acquisition, the Task Force recommends that students should enter college instruction at the appropriately challenging level and not be encouraged to repeat instruction at a level already mastered in the high school classroom. Here as in other recommendations of this report, there must be appropriate academic support services and programs to provide the necessary enhancement for students with differing learning styles and abilities.

In addition, a communicative approach to language learning is necessary if students are to function as world citizens in a global society. This approach includes using the language in real-life situations in the four skills: listening, speaking, reading, and writing. Students must also be well informed on cultural issues of the target language and should be able to use the language in real-life situations appropriate to the culture — to be able to say the right thing at the right time, rather than merely using language that is grammatically correct.

Students should be able to demonstrate the following competencies and skills:

Listening:

1. The student should comprehend clear, standard speech on familiar topics delivered with some repetition and rewording.
2. The student should comprehend the essential points of extended discussions and presentations on familiar topics.

Speaking:

3. The student should initiate, sustain, and close a general conversation.
4. The student should participate with some repetition and rewording in face-to-face conversations on familiar topics.

Reading:

5. The student should read selected authentic materials, information in non-technical prose, and expository texts on topics related to areas of special interest.
6. The student should analyze selected literary texts.
7. The student should use strategies (e.g., prior knowledge, key words, contextual clues) to understand unfamiliar texts.
8. The student should detect the overall tone or intent of a text.

Writing:

9. The student should compose unified and organized texts on everyday topics with increased accuracy.
10. The student should create simple versions of literary texts.

11. The student should edit his/her own pieces of writing (e.g., improve grammatical constructions, include connecting words, add appropriate verb tenses to indicate action in the past, present, and future).

12. The student should analyze and interpret selected, basic literary texts and other materials. (e.g., infer conclusions, justify characters' actions, describe preferences).

Culture:

13. The student should demonstrate a general appreciation of the culture of the target language.

14. The student should interpret and respond appropriately to common culturally-determined behaviors.

Pursuing these outcomes, the Modern Languages for Communications New York State syllabus (1986) defines three proficiency levels named Checkpoints A, B, and C. Their detailed descriptions for knowledge and skills mastery are included in Appendix C. Students entering college must first have completed Checkpoints A and B, usually after 10th grade (Regents Examination for Checkpoint B). During the remaining year(s) in high school students should begin work on Checkpoint C without interruption or work toward and take the AP test or other college credit-granting programs and examinations.

Special attention should be directed during the latter years in high school toward the development of writing skills with emphasis on increased accuracy. The development of reading for information and appreciation should be part of exploring the foreign culture at all levels. Exposure to various literary genres is recommended for optimum articulation. With this preparation, the "seamless transition" to the third, fourth, or fifth semester of college foreign language study (depending on Regents score and class grades) is assured provided there is no hiatus between 12th grade and the first semester in college.

Since knowledge and skills for Checkpoint C will be the domain of both high school and college levels, and since Checkpoint C curricula and examinations are still in development by school districts, close collaboration in the development of Checkpoint C between the faculties of both levels is recommended to enhance chances for success for entering freshman students.

After suitable placement tests assessing communicative ability have been developed, they can be administered to those students who enter the language sequences from points other than the one described above (such students would include nontraditional students, out-of-state students, and two-year college students who did not study language in their community college or college of technology). These tests should reflect the communicative competence students have attained in New York State high schools.

Any language should be considered an acceptable language for study and should be assessable at the levels described above. Performance criteria should be modified to reflect the difficulties of the "typical" American student's learning languages which are structurally very different from Western European languages. In the case of Ancient Language proficiency, in addition to meeting the minimum performance criteria for reading listed above, students are expected to comprehend classical texts normally taught in the third semester of college with the appropriate level of proficiency in vocabulary, grammar, and composition. For students whose native language is other than English, foreign language proficiency can be illustrated by earning a satisfactory score on a recognized test (such as the College Entrance Examination Board Achievement, Advanced Placement, or the Test of English as a Foreign Language tests).

3.2 Natural Sciences, Mathematics, and Technical Studies

The Task Force recommends adoption of a number of the proposals in *Project 2061: Science for All Americans* (American Association for the Advancement of Science, 1989), with only minor revisions as were deemed appropriate for the SUNY entry-level student. Sections A, B, and C are drawn in their entirety from that report; section C is reproduced verbatim.

A. Basic Dimensions of Scientific, Mathematical, and Technological Understanding

Students should be able to demonstrate the following expertise:

1. The student should be familiar with the natural world and recognize its diversity and its unity.
2. The student should understand the key scientific concepts and principles.
3. The student should be aware of some of the important interdependencies of science, mathematics, and technology.
4. The student should recognize that science, mathematics, and technology are human enterprises and as such characterized by certain strengths and limitations.

5. The student should develop the capacity for scientific ways of thinking.

6. The student should be able to use and recognize the use of scientific knowledge and ways of thinking for individual and social purposes.

B. Cultural and Personal Awareness of Disciplines

In order to be aware of the cultural context of and personal relationship to the scientific endeavor, students should understand the following ideas concerning science, mathematics, and technology.

1. The scientific endeavor is a combination of science, mathematics, and technology.

2. Each of the three fields (science, mathematics, and technology) has a long history that can be traced in cultures across the globe.

3. All three domains have intellectual, practical, emotional, aesthetic, and ethical dimensions.

4. Though the various natural and social sciences might be marked by different subject matter and/or technique, they share much in epistemology and values.

5. The study of sciences is evolutionary in terms of techniques, subject matter, instruments, and boundaries.

6. Mathematics is the science of abstract patterns and relationships.

7. Creativity is an important aspect of theoretical and applied mathematics as well as science and technology.

8. Technology broadens our ability to change the world by manipulating materials, organizing seemingly disorganized bodies of data, transporting materials, and extending our sensory perceptions and mental abilities further.

9. Technology necessarily interacts with society.

10. Procedures and findings of science are necessarily affected by the cultures in which they are performed and discovered.

C. Crucial Knowledge Areas

The essential areas of science, mathematics, and technology are the following:

1. The structure and evolution of the universe, with emphasis on the similarity of materials and forces found everywhere in it, the uni-

verse's response to a few general principles (such as universal gravitation and the conservation of energy), and ways in which the universe is investigated.

2. The general features of the planet earth, including its location, motion, origin, and resources; the dynamics by which its surface is shaped and reshaped; the effect of living organisms on its surface and atmosphere.

3. The basic concepts related to matter, energy, force and motion, with emphasis on their use in models to explain a vast and diverse array of natural phenomena from the birth of stars to the behavior of cells.

4. The living environment, emphasizing the rich diversity of the earth's organisms and the surprising similarity in the structure and functions of their cells; the dependence of species on each other and on the physical environment; and the flow of matter and energy through the cycles of life.

5. Biological evolution as a concept based on extensive geological and molecular evidence, as an explanation for the diversity and similarity of life forms, and as a central organizing principle for all of biology.

6. The human organism as a biological, social, and technological species—including its similarities to other organisms, its unique capacity for learning, and the strong biological similarity among all humans in contrast to the large cultural differences among groups of them.

7. The human life cycle through all stages of development, emphasizing the factors that contribute to the fullest development of human potential, and to improved life expectancy.

8. The basic structure and functioning of the human body, seen as a complex system of cells and organs that serves the fundamental functions of deriving energy from food, protection against injury, internal coordination, and reproduction.

9. The human population, including its size, density, and distribution, the technological factors that have led to its rapid increase and dominance, its impact on other species and the environment, and its future in relation to resources and their use.

10. Medical technologies, including mechanical, chemical, electronic, biological, and genetic materials and techniques; their use in enhancing the functioning of the human body; their role in the detection, diagnosis, monitoring, and treatment of disease; and the ethical and economic issues raised by their use.

11. The nature of technologies, including agriculture, with emphasis on both the agricultural revolution in ancient times and the effects on twentieth-century agricultural productivity of the use of biological

and chemical technologies; the acquisition, processing, and use of materials and energy, with particular attention both to the industrial revolution and the current revolution in manufacturing based on the use of computers; and information processing and communications, with emphasis on the impact of computers and electronic communications on contemporary society.

12. The mathematics of symbols and symbolic relationships, emphasizing the kinds, properties, and uses of numbers and shapes.

13. Graphic and algebraic ways of expressing relationships among quantities, including trigonometric functions.

14. Basic concepts and relationships of geometry from a synthetic and algebraic perspective, reinforcing relations between algebra and geometry through analytic geometric and coordinate systems.

15. Probability, including the kinds of uncertainty that limit knowledge, methods of estimating and expressing probabilities, and the use of such methods in predicting results when large numbers are involved.

16. Data analysis with an emphasis on numerical and graphic ways of summarizing data, the nature and limitations of correlations, and the problem of sampling in data collection.

17. Reasoning, including the nature and limitations of deductive logic, the uses and dangers of generalizing from a limited number of experiences, and reasoning by analogy.

(See Appendix D for details of the knowledge standards for areas 12-17 above; this development builds on the National Council of Teachers of Mathematics Report, *Curriculum and Evaluation Standards for School Mathematics*, 1989)

D. The Context of Science

To be scientifically literate, the student needs to understand the cultural and intellectual history of science, mathematics, and technology. The student should understand and show some familiarity with the following ideas.

1. The student should know some of the important events in the history of science and technology.

2. Science instruction should include discussions of the relationship between science and intellectual history.

3. Science education should introduce students to the practical implications of science and technology, including the impact of social institutions, ethical choices, and the role of science and technology in a global context.

E. Mathematics Anxiety

Of particular interest to mathematics education is "math anxiety" and its relationship to the underrepresentation of women and certain ethnic groups in mathematics (Tobias, 1990). At the same time, by virtue of the role that mathematics plays in many other fields, math anxiety is a problem for all students, not just those majoring in mathematics or mathematics education. Teachers must become sensitive to the types of behavior that can permanently "turn students off" to further mathematical interests and contribute to a loss of student self-esteem when confronting a situation involving mathematics. Many "math anxious" people can recall early embarrassing episodes that initiated an aversion to mathematics that persists into the adult years. Mathematics should be taught in such a way that the student builds self-confidence with the subject matter and does not develop an expectation of inevitable failure.

Just as is true for other teachers, math educators should attempt to avoid even subtle or unintentional forms of racial, ethnic, or gender stereotyping. Historical and anecdotal references may be used to illustrate that mathematics is not the exclusive domain of the white male. Successful and useful models are readily available in the achievements of Jaime Escalante and Uri Treisman with underrepresented minority students and in the writings of Elizabeth Fennema and Sheila Tobias about special programs to encourage young women math students in their elementary and high school years.

In avoiding situations that produce math anxiety, however, math educators should continue to address the problem of "innumeracy" in American society (see the popular book *Innumeracy* by John Paulos). Douglas Hofstadter writes that "innumeracy — the mathematical counterpart of illiteracy — is a disease that has ravaged our technological society." It is common for people to speak unabashedly of their inability to do even simple mathematics, to confuse orders of magnitude, and to have little awareness of the degree of risk involved in everyday activities. A graduating high school senior should at the very least be able to deal comfortably with numbers, have a "feeling" for the use of statistics, and understand probability as these topics relate to everyday life and basic common sense.

A correlative of math anxiety is some students' perceptions that mathematics is a sterile, unchanging subject developed in antiquity. To correct this perception, mathematics instruction should be enriched with biographical and cultural examples and anecdotes; students should learn that mathematicians both profoundly influence their culture and are influenced, limited, or sidetracked by their prejudices and the prevailing notions of the cultures in which they live. Mathematics instruction should also feature mathematical modeling of contemporary problems. As soon as possible in their education, students should understand that most of mathematics is a human invention, some parts of which have no necessary counterparts in the real world, while other parts undergird the science and technology that so influence our daily lives.

3.3 Social Sciences and History

The foundations of social science and historical methods of critical inquiry and examination are important preparation for college-level work. The College Board publication, *Academic Preparation In Social Studies: Teaching for Transition from High School to College* (1986), was found to be a particularly useful resource for curricular examples and approaches of the kind recommended by the Task Force. The study of social sciences and history should be viewed in a broad and inclusive approach that would accomplish the following goals:

- encourage critical thinking, analysis, problem solving, conflict resolution, decision making, and debate and discussion, through the use of basic concepts and insights from all social science disciplines and history, leading to a better understanding of and tolerance for differences;
- develop an understanding of the methods as well as the content of social science and history;
- foster positive attitudes towards community service and contribute to a harmonious and diverse college environment.

The student should be exposed to the widest possible spectrum of historical and social science content. Broad-gauged historical approaches permit coherent integration of history and social science along with pertinent concepts and approaches from other disciplines.

A. Interrelationships

1. Key concepts from sociology, psychology, economics, human geography, and anthropology should be taught within the secondary school curriculum.

E.g., such concepts could include power, equity, gender, class, status, subjugation, diversity, economic systems, democracy, national culture, subculture, global culture, citizenship, cultural differences and controversy, race, cultural values, and norms.

2. Secondary studies should address the physical environment within which society lives, through contributions from physical geography and the environmental sciences.

3. Students should acquire an understanding of the development, ethical considerations, and role of technology in society.

4. Concepts from applied areas of study such as law and business should be appropriately interwoven throughout the curriculum.

   E.g., these concepts could include strategic planning, contracts, property, due process, liability, terrorism, corruption, the rights of political refugees and illegal aliens, civil liberties, and affirmative action.

5. The mutual influence of social history and parallel developments in the humanities and arts and in science, mathematics, and technology should be explored, stressing the integration of themes, causes, and effects, and the notion of the "spirit of an age."

6. Appropriate attention should be given to the contribution of women and members of traditionally under-recognized groups throughout history and in the present.

7. Students should become aware of the use of language in influencing social attitudes and behavior.

8. Students should be introduced to interdisciplinary policy studies and their topics.

   E.g., examples might include benefit/cost analysis, environmental impact analysis, game theory, graphic representation, and input-output models.

B. Global Issues

1. Students should comprehend the economic and political changes that are affecting nations and international relations.

2. Students should acquire an ability to identify and describe key elements of global transformation.

   E.g., examples might include commerce, finance, markets, information dissemination, technology, resources, international development, interdependence, geography, ecology, transportation, and the activities and decisions of governments, transnational enterprises, and international agencies.

3. Students should be able to relate these elements to the disciplines and professions that study them and to the methods they use.

4. Students should know historical contexts that exemplify these phenomena; some historical examples will refer to critical events and eras.

   E.g., examples might include agricultural and industrial revolution, age of exploration, atomic fission development, moveable type, Reconstruction, the Reformation, the rise of nationalism, and science and technological development.

C. Major Issues of Social Science Study of the United States

1. Students should understand the development, influence, history, and contributions of the peoples of the United States by:

   - acquiring a clear understanding of commonalities in our national traditions, their many origins and cultures, and the richness of their diversity and pluralism;

   - understanding the democratic process and the sources of our commitment to democratic participation and constitutional government;

   - identifying past, continuing, and new national challenges and efforts to develop and implement policy responses

     E.g., such challenges and efforts might include drugs, the environment, health care, homelessness, the labor movement, poverty, slavery, and taxation.

2. Students should recognize how inequality and intolerance compromise efforts to achieve justice in America.

3. Students should understand the terms diversity, pluralism, and equity, and their applications to modern American society. For example, in the social context, "diversity" refers to ethnic and cultural differences, and it can also refer to lifestyle and ideological variations as well as diverse groups. "Pluralism" recognizes the existence of different groups (particularly ethnic and cultural) that we should understand and appreciate. "Equity" implies equal opportunity, remedies for historical inequities, and the supports necessary for success.

4. Students should be knowledgeable about the development and history of decision-making processes in pursuit of equitable and/or efficient distribution of scarce resources and of power in a national and international context:

   E.g., such topics as the following might be included: energy, the balance of trade, civil disobedience, expansionism, public education, scarcity, suffrage, migration, and markets.

5. Students should comprehend the role and impact of the media.

   E.g., areas of study could include elections, advertising, stereotyping, prejudice, and education.

D. Social Science Methods

Students should have a basic understanding of:

- conceptualization and modeling;
- social behaviors and decision-making;
- powers and limits of statistical inference;
- social causation and the development and evolution of competing social science models;
- ethics in the conduct of research, issues analysis, and policy formation.

E. History Methods

Students should have a basic understanding of:

- the way in which historians attempt to describe and explain human behavior, thought, and experience;
- the ways that history has served the political and public policy concerns of the state;
- the diversity and temporal nature of historical interpretations;
- the need for research in and evaluation of primary documents and other data representing the human past.
- ethical questions and responsibilities of historical research and writing.

Section 4
ASSESSMENT

4.1 The Charge and the Context

The charge to the Task Force asked: What program of study and form of assessment will enable the University to determine that prospective students have accomplished these expectations for successful entry-level collegiate study? The question recognizes that curriculum (program of study) and assessment are necessarily and usefully linked and we must therefore address them jointly. However, the State University is not the only arbiter of student learning outcomes; students, parents, teachers, and school systems are equal stakeholders, whose interests, along with those of society as a whole, also must be served by any new system of assessment.

As noted earlier in Section 1.2, New York State in 1992 stands on the threshold of a major opportunity for curricular and assessment reform. For maximum effect, our work in SUNY should take account of, and wherever possible reinforce or complement, the parallel initiatives under way elsewhere in the public education sector. *A New Compact for Learning* offers several important principles and directions on which we can build:

- "High school graduation will be contingent upon satisfactory completion of a secondary-school assessment, as well as upon the number of courses completed. This assessment will be, not a one-shot final examination, but a series of measures taken over time until satisfactorily completed. . . . The purpose of the assessment will be to assure that students have acquired the requisite skill and knowledge, not to rank their accomplishments against those of their peers."

- "The existing State testing program, except for Regents examinations, will be revised. Assessments will not be limited to multiple-choice, standardized tests, but will include components such as the following:

    - Examinations which measure problem-solving skills and the ability to analyze and synthesize, as well as factual recall.

    - A portfolio of the pupil's best work, certified by his/her teachers and evaluated by qualified raters.

    - A professional evaluation of the pupil's accomplishments made by his/her teachers. This evaluation should extend not only to basic skills and knowledge but also to desirable qualities (such as persistence, creativity, and sensitivity to others) not easily measured by conventional means."

(A New Compact for Learning, 1991, p. 6)

While the SUNY Task Force has been conducting its deliberations in 1991-92, our colleagues in the City University have designed and adopted a College Preparatory Initiative. The CUNY approach is formulated in terms of recommended numbers and distributions of preparatory course units to be taken preferably in high school or, if not, to be completed in college. Although the exact definition of acceptable units has yet to be determined, there appears to be a reasonable working correspondence with Regents courses. To the extent that the two public university systems share the common goals of improving student preparation for success in college, we will realize great benefits if we can deliver our messages to the students, parents, and schools of the State in ways that are understandable and translatable.

4.2 Principles of Assessment

An appropriate assessment of the skills and knowledge described earlier in this report must accommodate at least three factors: the various kinds of learning and understanding involved in the skills and knowledge of different fields; the range of abilities and experiences of individual students; and the diversity of programs and institutions in State University for which student preparation must be assessed. Given such complexity, it is readily apparent that no single test nor even a single approach to assessment could address adequately the needs of all the constituencies involved.

We also decided at the outset to focus upon methods of assessment that could be implemented in the high schools, thus targeting the "traditional" college student. We certainly recognize that the division of students into "college-bound" and "non-college bound" is an arbitrary one and that numerous individuals do not decide to pursue postsecondary education immediately after graduating from high school. Although changes that are implemented in the high schools now will affect these adult students of the future, we did not attempt to address assessment of the current adult student population.

The Task Force began its work on assessment by attempting to articulate the principles we felt should guide our thinking in reviewing and judging options:

1. Assessment of knowledge areas should include multiple measures of student evaluation such as portfolios, projects, and other evidence of "authentic" performance, as well as traditional examinations (e.g., Regents Examinations, local examinations, standardized tests). An assessment program may begin with existing evaluation mechanisms but must extend beyond paper-and-pencil tests to more authentic assessment methods.

2. The levels of evaluation should include *recall* of information,*integration* (how recalled items relate to each other and underlying principles), *problem-solving* (organizing facts and principles to arrive at a conclusion), and *application* (applying information and principles to a new problem or situation).

3. Assessment of knowledge areas should span all four years of high school and, whenever possible, should be embedded in on-going classroom activities. The assessment should ask students to link present with past learning in a subject.

4. The areas to be assessed should include writing skills, literature, mathematics, science, social science, arts, and foreign languages. Assessment should be linked to the objectives for learning in the subject and whenever possible should assay authentic performance skills.

5. Assessment should focus on assisting the student to attain the desired knowledge and skill levels, rather than providing a summative evaluation of teacher performance.

6. Assessment should be designed to survey possibilities for student growth and improvement, rather than to deny students access to educational opportunities.

7. Assessment results must be reported in a way that is understandable and useful to students and parents as well as to schools and colleges. Responses to students should be timely in order for assessment to serve a formative function.

In deriving these principles and considering alternative forms of assessment, the Task Force determined that nationally standardized testing would not provide by itself the kind of comprehensive and formative experience we are seeking. While we encourage the new directions the testing companies are taking, such as The College Board's *Pacesetter* program, currently available aptitude and achievement tests do not meet a major portion of our needs. Such tests will continue to be taken by students and used by colleges and universities for various admissions and placement purposes. Where available, they add valuable supplementary information to other more authentic approaches, but the Task Force neither endorses nor rejects any particular commercial instrument.

It will be a tremendous challenge for New York State to incorporate authentic assessment methods into an already established assessment system that has developed on a foundation of traditional standardized tests. These newer methods have evolved out of different philosophical perspectives based on different assumptions about the nature of knowledge and ways in which students learn. Reform of the State's assessment system will probably be gradual and, at least initially, the two approaches may complement each other: standardized testing may remain a relatively efficient means of examining the acquisition of certain elements of knowledge and particular skills, while authentic assessment methods, such as portfolios, are used to examine students' abilities to apply desired knowledge and skills in meaningful ways.

4.3 Authentic Assessment

As noted in the first of our principles of assessment, the Task Force strongly endorses the current notions of "authentic" or "performance-based" assessment. While much of traditional forms of evaluation could be characterized as somewhat contrived, abstract, and tangential to students' life experiences, **authentic assessment** evaluates students by processes that are similar to those used by professionals in the field. Such assessments are not disconnected from the real world and are likely to be encountered by the student as a citizen or consumer. Authentic assessment aims at the core of the curriculum — the "big ideas" — leading discussion to other problems and questions of importance.

Performance-based assessment evaluates students by asking more directly for the behaviors that the teacher wishes to produce; it is obviously consistent with the notions of authentic assessment (indeed, some authors treat performance assessment as a type of authentic assessment). Compared to traditional testing, it typically involves a more extended process of judgement by the teacher and more extensive products on which the student is to be evaluated. Rather than relying on the limited sampling of a student's knowledge and skills that can be realized through a short-duration standardized pencil-and-paper test, performance-based assessment can include recorded conversations in a foreign language, teaching observations, laboratory experiments, individual and group projects, responses to open-ended questions, exhibitions, interviews, and portfolios.

The Task Force recommends that high school students:

- beginning as early as the 9th or 10th grade, engage in a continuous authentic assessment experience that is maintained throughout their high school years; and

- create an assessment product that could be taken with them to college and used there for academic planning and advisement.

As University faculty, we should not presume to prescribe the details of the assessment product and experience most appropriate for all schools in New York State; rather, we need to work with our school colleagues to explore the realm of possibilities in which the University can both contribute to and support change. The Task Force offers the following suggestions as starting points for those discussions.

A. Portfolios

Portfolio assessment is already a familiar approach to the evaluation of learning outcomes in the postsecondary sector around the country; and, within New York, some SUNY campuses have developed portfolio methods in our own undergraduate assessment initiative. In the elementary and secondary sector, *A New Compact for Learning* clearly opens the door to portfolio assessment in New York State, and Vermont's adoption of statewide portfolio assessment in writing and mathematics at grades 4, 8, and 11 will probably provide further encouragement.

In order for portfolio assessment to be a developmental and formative process, the students should work in conjunction with their teachers to establish criteria for assessment and should take more responsibility for their education than under traditional methods of assessment. Counselors and parents must also understand the process and be engaged in it.

The content of a portfolio could include essay exams, term papers, other performance exams, projects, lab reports, computer programs, evidence of thinking processes in mathematical and scientific problem-solving, experiments, exhibitions, artistic creations, and other innovative assessments of imagination and perseverance. The methods of assessment could include clinical-type ratings by teachers and self-ratings by students. Peer evaluations in both individual and group or team projects could provide a valuable supplement to the assessments of teachers and students themselves, emphasizing the culture of cooperative teaching and learning.

Portfolio assessment will ask more of and provide more to teachers as well as students. The assessment system should be designed to involve feedback loops to teachers and administrators, providing increased insight into opportunities for curricular improvement. Costs in dollars and time will be significant; early experience in the Vermont system suggests that the major investment needs for portfolio assessment are in teacher training and continuing professional development.

B. Assessment File

Portfolios in one or more critical subject areas may be combined with other assessment instruments in a more selective assessment file that the student carries with him or her to college. Regents Examinations or Competency Test results and nationally-normed standardized test scores could also be included in the assessment file.

Completion of the assessment file would be part of the assignment for the High School Senior-Year College Preparatory Course (see Academic and Personal Support Skills, page 13). This course would:

- teach time-management and stress-management skills;
- discuss goal-setting, brainstorming, teamwork, independent and collaborative group learning, and other dimensions of problem-solving strategies;
- enlighten students about college academic and personal support services and learning resources;
- promote effective study and learning techniques;
- orient students to the differences between the high school and college environments;
- introduce students to academic expectations in the various college majors, and;
- serve as the capstone assessment course in which students and teachers analyze and evaluate the class portfolios.

By grade 12, a student should have several portfolios from which he/she could select a few works in a particular area that illustrate the student's development, progress, and best efforts. The student should also provide a written self-evaluation, including reasons for selecting these samples for evaluation. One of the most important benefits of a selective assessment file is the process the student goes through in determining to include certain pieces and exclude others. The teacher might also provide anecdotal assessment and a checklist of the student's level of proficiency in a particular subject area.

An assessment file, built over three or four years of the student's high school career, would bring to college faculty, advisors, and counselors a richer and more useful perspective on the student as a developing and growing person than the present array of standardized aptitude, achievement, and placement tests. A student's portfolio materials could be used to decide if a student needs developmental work, might be placed in regular college-level course work, or could be exempted from introductory college course work and given more advanced standing. The portfolio could also support a student's placement in honors programs.

A number of schools in New York State, for example the Alternative Community School in Ithaca, appear to be using authentic assessment and portfolio review productively. In order to establish the validity of these techniques for statewide use more work needs to be done, and SUNY should take a leading role in it. The savings in freshman year attrition and sub-optimal performance by students will, we believe, more than offset the additional time and costs invested in this endeavor.

4.4 Early Alert and Intervention

Consistent with the principle that assessment should be timely and usable by students and schools as well as by the University, the Task Force explored the potential of an early alert and intervention model originally developed in mathematics at Ohio State University. We believe that the general approach embodied in the Ohio Early College Mathematics Placement Testing Program could be of enormous value to SUNY and the schools, and not necessarily limited to the field of mathematics.

The Early College Mathematics Placement Testing (EMPT) Program was established in 1977-78 as a cooperative pilot project between Ohio State University and Westland High School in Galloway, Ohio. This system of early alert and intervention in the high schools encourages students to take actions that will bring them to college better prepared for their preferred course of study and less in need of remediation during their freshman year. Since mathematics is an important tool in a variety of academic programs, an inadequate mathematics background will limit a student's options at the university level.

The **early alert** is given by offering high school juniors an assessment of their preparation in mathematics in terms of the requirements in their desired programs at the Ohio college or university of their choice. This is not an application for admission, but rather a way of providing meaningful context for the student: "if you were to go to the college you have indicated to take the program you have selected as your first choice, then these are the deficiencies in mathematics you should make up in order to start college fully prepared." The assessment is accomplished through a placement test drawn up by college faculty and administered at the student's local high school. Participation is voluntary for both schools and colleges and for individual students. Aggregate results are provided to the students, their guidance counselors and mathematics teachers, and to their parents.

The **intervention** is provided by the direction towards corrective measures that the student can take during his or her senior year in high school. Each student receives a personal performance assessment along with a description of the mathematics requirements for her or his intended major and an indication of what remedial courses would be required if mathematics skills remained at the tested level. As a direct result of the dialogue between high school mathematics teachers, guidance counselors, and college mathematics faculty, several major school mathematics curriculum revision projects have been initiated in Ohio, providing the formal intervention structures that actually improve mathematics learning and teaching in Ohio high schools (Waits, 1990).

The outcomes obtained through EMPT have been extraordinary:

- Senior-year enrollments in mathematics at participating high schools have increased on the order of 40-45% and have been sustained.

- Largely as a result of the EMPT program, the proportion of freshmen taking remedial mathematics courses at Ohio State University has declined from 47% in the late 1970s to 20% in the 1990s. The proportion of students from EMPT schools that need remedial mathematics is about half that of those from non-participating high schools.

About 75% of the high schools in Ohio participate in the EMPT program and over 60,000 high school juniors are assessed each year. The program has been funded by the State Legislature since 1983. Some 20 other states have adopted or implemented programs modeled upon the Ohio EMPT.

The Task Force recommends that a similar early alert and intervention model of assessment be developed in New York State:

- beginning with mathematics, but with the potential to expand into other major disciplinary areas as results and savings are realized and as funding becomes available;

- perhaps beginning with some pilot projects developed within SUNY until broader collaboration and funding becomes available; and

- perhaps eventually based on the revised comprehensive final examination of the second unit of high school mathematics.

Such an assessment program must be structured, as in Ohio, in such a way that it remains separate and distinct from the college admissions process and that its results are not made public in a manner that could be misused to rank or grade high schools. We believe that such a program would send a powerful message to students and parents about the value of academic preparation for collegiate work and the costs of delaying remedial work until the college years. It should help to improve curricula at both high school and college and should lead to increased retention and greater learning productivity in the University.

In recommending an early alert and intervention model along the lines of the Ohio EMPT Program, we are not oblivious to the fact that many decisions and behaviors of great import for a student's academic prospects take place before the 11th grade. Indeed, the Task Force considered calling for an earlier application. The question is where to start in order to realize the quickest benefit. Some demonstrable success is essential to changing attitudes and rebuilding support for longer-term reforms. In order to avoid a high-risk admissions testing situation, the early alert model in the 11th grade seeks to capitalize upon the point of maximum student interest in preparation for college: prior to 11th grade, college is still a somewhat distant attraction; by 12th grade, admission itself becomes the dominant consideration.

4.5 New York State High School Curricula and Tests: A Brief Summary and Some Recommendations

New York State was the first state in the nation to develop and administer statewide testing for elementary and secondary school students. Today, the New York State Education Department operates the largest testing program in the country and, unlike most other states, develops most of its own tests in cooperation with hundreds of classroom teachers. Two elements of the State testing program — the Regents Examinations and Competency Tests — address the learning of high school students and offer some assessment of the knowledge and skills acquired through secondary education.

New York State Regents Examinations have been offered since 1878 and presently cover 16 areas or levels of study:

- comprehensive exams in English and Foreign Languages, typically taken after three years of study;
- annual exams for each year of the sequential Mathematics I-II-III curriculum, typically taken in grades 9, 10, and 11;
- annual exams for each of the four sciences (earth science, biology, chemistry, and physics), typically taken in grades 9 through 12; and
- two exams in social studies, one covering two years of global studies typically taken in grade 10, and the other after a year of United States history and government taken in grade 11.

Regents Examinations are intended for college-bound students and in recent years one or more of them have been taken by about 60 percent of the high school population. Administered for the most part in January, June, and August each year, these tests are scored locally with a sample of papers reviewed centrally in the State Education Department.

Regents Competency Tests were introduced in 1979 to establish minimum standards in reading, writing, and mathematics for receipt of a local high school diploma. Following the Regents Action Plan in 1984, additional competency tests have been developed in science, global studies, and United States history and government. The full set of competencies became requirements for graduation in 1992.

As now conceived and operated, Regents Competency Tests are intended to ensure that students have met minimum requirements for high school graduation. The minimal standards of these tests are below the expectations described earlier in the skills and knowledge sections of this report.

Recommendations

The Task Force recognizes that students who successfully complete Regents-level or higher-level courses have advantages when they enter college over those who take predominantly non-Regents programs. Accordingly, we recommend that Regents courses, or other courses of equal or greater rigor, be made available and accessible to all students who wish to take them and that as many students as possible be encouraged and counseled to take Regents courses and examinations.

The Task Force believes that if Regents courses and exams are to continue to play a central role in helping prepare New York students for college, serious consideration should be given to redesigning them to include more authentic assessment. Such a redesign should be directed toward gauging more effectively students' ability to synthesize and apply knowledge and skills.

The Task Force also recommends a number of particular modifications and extensions to current Regents course curricula and Regents Examinations in order to provide a more thorough assessment of students' attainment of college entry-level knowledge and skills as defined in Sections 2 and 3 of this report:

A. English

The Regents Examination in English should include all four areas of communication skills listed in Section 2.3 of this report: reading, writing, listening, and speaking. The writing component should be more challenging. Substantial amounts of written work should be assessed through local exams, portfolios, and projects in all grades, but especially in Regents high school courses.

B. The Arts

Evaluating student achievement in the arts by means of student productions, performances, projects, portfolios, journals, critiques, and summative experiences seems particularly appropriate to the Task Force.

C. Foreign Languages

The Regents Examinations in Foreign Languages employ authentic assessment. In addition, students should develop portfolios in foreign languages.

As indicated in Section 3.1-C of this Report, the *Modern Languages for Communications* New York State syllabus (1986) defines three proficiency levels: Checkpoints A, B, and C. Students entering college must first have completed Checkpoints A and B, usually after 10th grade (Regents Examination for Checkpoint B). During the remaining years in high school students should begin work on Checkpoint C without interruption. Since knowledge and skills for Checkpoint C will be the domain of both high school and college levels, close collaboration on the development of Checkpoint C curricula and examinations between the faculties of both levels is recommended to enhance chances of success for entering freshmen.

D. Science and Mathematics

Students intending to major in a science, engineering, or elementary education should complete four years of high school science. All other students should take a minimum of three years of sciences with an observational laboratory. The high school sequence (earth, environmental, biology, chemistry, and physics) represents an orderly progression from empirically-based sciences to the more analytical disciplines. Potential elementary educators require a broad background in science and should be encouraged to start developing their knowledge base as early as possible.

Students who wish to major in mathematics, a physical science, or computer science will be well served by experience in the use of a procedural (higher-level) computer language such as Pascal. Students who wish to major in physics or engineering are strongly advised to take calculus, Advanced Placement Calculus, or the equivalent during their last year in high school. Upon entry into college this student should be able to differentiate and integrate polynomials, trigonometric, exponential, and natural logarithmic functions. Graphical interpretation of the first and second derivative of a given curve and interpretation of integration as the area under a given curve should also be acquired. Students who do not have an opportunity to take calculus in high school but who still possess a mastery of the basic analytical skills are not precluded from a physics/engineering course of study; however, they should enroll in a mathematics course during their senior year that will expose them to the above topics.

There was agreement within the Task Force from both college and high school mathematics, scientific, and technical faculty, as well as college advisors, that the New York State Sequential Mathematics Courses I, II, and III are not developing the broad analytical skills listed in the Analytical Skills section of this report. It is therefore recommended that the curriculum, syllabi, and levels of rigor and complexity of the sequential mathematics program be re-examined and revised using the National Council of Teachers of Mathematics Standards as a reference. In the spirit of *A New Compact for Learning*, we recommend that this re-examination and revision be performed through a collaboration between university faculty and the secondary school community. The Task Force's concern is further underlined and substantiated by the inferior performance of United States students on international mathematics examinations and the attrition in upper-level high school and college mathematics and science courses.

The Task Force recommends the following specific reforms of State curricula and tests in mathematics:

- The final examination for each unit of high school mathematics should be comprehensive for that unit.
- Mathematics should be studied in every high school year, regardless of the speed with which a student moves through the curriculum.
- A comprehensive, cumulative evaluation covering the three units of mathematics should be made near the end of the senior year. The results of this evaluation should be made available to the college the student attends for possible use in initial course placement. The university and secondary school collaborative committee referred to above should discuss this issue.
- All examinations in mathematics should have significant problem-solving components in addition to any multiple-choice or short-answer questions.

E. Social Sciences and History

The Task Force reaffirms that four units of social studies be a continued requirement for high school graduation. The goals, concepts, and substantive areas of the social sciences and history outlined in Section 3.3 appear compatible with much current usage and expectation.

However, the two existing Regents exams in the areas of social sciences and history constitute neither a sufficient nor a comprehensive means of determining how well students have achieved learning in the realms outlined in Section 3.3. The Task Force recommends the development of additional authentic assessment methods, including an emphasis on student writing and the observation, collection, and recording of student activity and performance in each course.

We strongly favor formative and developmental methods of evaluation and the use of portfolios to encourage students toward their best and most satisfying levels of achievement. Teachers also need to present and transmit the large amounts of often subjective information generated for each student in concise, summative statements, possibly still including grades.

In some 12th-grade social science subject areas, such as economics and Participation in Government, expectations for student learning and for the means of assessing it are not so clear as they might be; this lack of clarity has contributed to inconsistent learning outcomes and reporting of outcomes from school to school. We believe this situation merits study and movement toward greater consistency throughout New York State.

The 10th-grade Global Studies Regents Exam was designed to measure two years of student achievement. It is considered flawed in its intent to measure 9th-grade learning and, partially as a consequence, it also does not adequately account for the depth of 10th-grade studies. We believe the Global Studies Regents should be a one-year exam for the 10th grade, similar to other Regents Exams. A new means for obtaining an evaluation of 9th-grade Global Studies should be developed.

Section 5
ENRICHED CHOICES AND ACCELERATED PROGRAMS

5.1 The Charge and the Context

A statement on expectations for college entry-level knowledge and skills need not focus solely on the minimum preparation that would make student success in the freshman year likely. The Task Force therefore was asked to address the question: what levels of mastery of entry-level knowledge and skills could help to identify students for advanced standing, special honors programs, accelerated associate and baccalaureate programs, and time-shortened joint baccalaureate and graduate or professional programs? Since the level of mastery required for each such accelerated or enriched program in each SUNY college is a matter to be decided by the relevant faculty, the Task Force decided to focus its recommendations on the provision of opportunities and challenges for better-prepared college entrants.

A common complaint about college-bound high school students in New York is that they do not work up to their potential during their senior year. Since most will have completed their Regents Examinations in their junior year, and since colleges often depend almost entirely on records of their first three years, too many high school seniors choose too few demanding academic courses in their last year of school, forgetting some of the subjects they will most need to remember in college, and losing valuable time. The High School Senior Year College Preparatory Course proposed earlier in this report is an example of a productive, integrative effort that may help to engage seniors.

Actually, SUNY colleges currently offer a variety of opportunities to better-prepared students, including invitations to compete for merit scholarships, and choices that allow students to enrich their college experience through honors programs and additional majors and minors, or to shorten their time to the baccalaureate or a graduate degree. Unfortunately, appropriate information about many of them is not provided to high school guidance counselors, and some of them are being forced out of existence for lack of funds, both in SUNY and the public schools. Moreover, students whose high school studies qualify them to place out of beginning college courses often are unaware that they may do so; indeed, they may be allowed, encouraged, or even required to take courses that duplicate their high school work.

To reaffirm the value of excellence in studies and of a demanding senior year of high school, we recommend the following steps.

5.2 Recommendations

Non-duplication

1. Colleges should take suitable care to see that students do not duplicate in college work they have already completed in high school. Students may believe they will ease their transition to college or improve their grades by selecting beginning courses in foreign languages they have already studied, or by repeat-

ing calculus, or by retaking AP subjects in which they did well. They should be advised against repeating such work, and discouraged from doing so. On the other hand, academic departments may believe that superior senior courses or advanced placement courses in high school do not cover the ground of their entry-level courses. We urge such departments to verify their belief by examining the high school syllabi, or in one of the ways discussed in recommendation #2 below.

Course Challenge

2. SUNY colleges should give students the opportunity to challenge specific courses by demonstrating their mastery of the course outcomes, and should award credit toward the degree for successful course challenges. Students accepted to a given college might be allowed to challenge courses before or after their arrival on campus. In some instances, the challenge would involve skills or knowledge that are not reflected in the high school transcript, such as proficiency in a foreign language learned abroad, or in a musical instrument. Demonstration of mastery might involve presenting a portfolio or other form of authentic assessment, or passing the final examination for the course. A list of individual college policies on course challenge should be made available to all high school guidance counselors.

Advanced Placement Credit

3. All SUNY units should follow the SUNY policy in granting credit toward the degree for advanced work in high school, as evidenced by suitable scores on Advanced Placement examinations, College Level Examinations (CLEP), and Regents College Examinations (RCEP). SUNY campuses should similarly recognize successful completion of college courses taught in the high school as well as other courses, such as those of the International Baccalaureate, that exceed senior Regents courses in their requirements. A list of individual campus rules in regard to such credit should be made available to all high school guidance counselors.

Expansion of Advanced Placement Opportunities

4. High Schools not presently offering AP courses should be enabled to do so, if they wish, through appropriate funding. In 1991 only some 230 of the 1,400 high schools in New York State offered such courses. For some schools, AP courses might be made possible through telecommunications, and the possibility of assisting these schools through the SUNY satellite should be explored.

Delivery of Instruction

5. SUNY should recognize the offering of college courses in high schools by college faculty as part of the public service mission of the university. Since, at present, it is not realistic to suppose that many SUNY colleges will be able to spare faculty to teach in the high schools, SUNY colleges should explore the possibility of offering college courses to high schools via distance learning technologies.

Early Enrollment in College Courses

6. SUNY should encourage well-motivated students to enroll in college courses while still in high school. Although the value of college courses taught in the high school is not in question, the experience of actually attending courses with college students in the atmosphere of college teaching and expectations is different in kind and provides a strong bridge to college itself. However, high school students will need help from SUNY in attending courses at their local SUNY unit, specifically, help in scheduling and registration and help with transportation to the campus. The first can be provided by the college—and is so provided by SUNY units presently sponsoring such programs. The second may involve funding for a special bus or the extension of an existing route.

Honors Programs

7. SUNY should seek funding to support college honors programs or honors sections of courses, to enrich the academic experience of well prepared entering students. Many SUNY colleges have had such programs in the past, but almost half are shrinking or being discontinued. Admission to honors programs or courses should be based on student portfolios or performances or other evidence of readiness, and not solely on test scores. A list of honors program entrance requirements of the individual colleges should be made available to all high school guidance counselors.

Scholarships

8. SUNY and its individual units should find ways of increasing the funds available to provide scholarships for high achieving students, whether in connection with honors programs or not. Some scholarships might be available to incoming freshmen, others to SUNY students who compile enviable academic records after matriculation. As the Task Force has urged in other contexts, portfolios or evidence from other kinds of authentic assessment should be used in identifying suitable students, together with grade-point averages; standardized test scores should not be used for this purpose in isolation.

Early Admissions

9. SUNY colleges should be encouraged to admit as freshmen qualified high-achieving students who have not finished high school (early admissions). At

present, all SUNY schools are listed as offering this opportunity, but few students seem to be recruited. For each student so admitted, the college should furnish a transcript for the student's freshman year to the high school, which then should grant the student in good standing a high school diploma.

5.3 Two Examples of Enrichment and Acceleration

SUNY currently offers several accelerated and enriched baccalaureate degree programs. Brief descriptions of two of these follow as examples.

- State University of New York College at Fredonia

The 3-1-3 program at the State University of New York College at Fredonia is a time-shortened, combined high school and college course of study which can lead to a B.A. or B.S. degree in three years after high school graduation. This is possible because the college gives credit for the successful completion of selected high school courses and the high school allows successfully completed college English and social science courses to count toward the high school diploma. Therefore, the name 3-1-3 means three years of high school, three years of college and one transitional year during which the student is enrolled simultaneously at his/her high school and at the college. During the transitional year, the student continues to live at home while commuting to the Fredonia campus for college courses.

The program was inaugurated in 1972, primarily to save students a year's time and tuition on their road to a bachelor's degree. A number of other reasons for choosing the program have emerged over the years as a result of the flexibility allowed by adding the choices of a college curriculum to a high school schedule. Many former 3-1-3 students have found the year to be a valuable stepping stone to the more total independence of college away from home, as well as making it possible for them to qualify for very competitive programs, fit in a second major, or discover an entirely new interest. At the same time, the program has continued to save many students and their parents a year's tuition and room and board at more expensive schools.

The 3-1-3 program is for the interested, committed, and motivated student. Certainly, academic ability is needed, but 3-1-3 is not a program for only the most academically gifted. A wide variety of students have used the 3-1-3 year as a beginning to a successful college experience.

- State University of New York College at Brockport

Delta College is a "college within a college" at SUNY Brockport. It offers students a small-college feeling while giving them access to all the facilities of the larger parent College. By limiting the size of classes and altering the course structure, Delta College encourages close contact with

> both professors and fellow students. Students in the Delta College also participate in small seminars to discuss the program and their own progress with professors who advise and counsel them on career goals and academic majors.
>
> Delta College's Flexible Program option allows a student to complete the minimum requirements for an undergraduate degree in as little as three years, rather than in the four years typically required for the bachelor's degree. This acceleration is possible because a series of interdisciplinary courses eliminates the duplication that sometimes occurs between high school and introductory college courses.
>
> The program flexibility allows students to spend a full year of college in a personally and academically enriching way. For example, many students spend their junior year studying overseas. Others may spend one semester of the junior year and one in the senior year pursuing internships or cooperative education. Some use the flexible time option to complete a second major, acquire teacher certification, or begin graduate study. It also is possible to graduate after three years and start a career.

The Task Force would like to see more such opportunities offered more aggressively by SUNY.

CLOSING STATEMENT

The recommendations of entry-level knowledge and skills contained in this Report are not admissions standards, nor are they a description of the preparation with which most students currently come to SUNY. Rather, they represent the University's attempt to state forthrightly the level of knowledge and skills it would like its incoming freshmen to have. This information is conveyed to encourage those involved—pupils, parents, teachers, school administrators, guidance counselors, school boards, and education policymakers—to see to it that pupils pursue coursework that keeps their options for college study as open as possible.

One of the recommendations intended to assist students in meeting the University's expectations, the Mathematics Alert Program, has already been proposed as a joint effort of SUNY, the City University of New York, and the State Education Department in their 1993-94 budget plans. Next steps include development and implementation of the recommended High School Senior-Year College Preparatory Course in cooperation with school colleagues, and SUNY's collaboration with the State Curriculum and Assessment Council to help define the skills, knowledge, and understanding that students in elementary, middle, and secondary schools need to acquire, as well as measures for assessing that acquisition.

In preparing this Report for the Chancellor and the Provost, the members of the Task Force have started a number of conversations, on our campuses and with representatives from the public schools. We have listened to as many comments and reactions as we have been able to gather; they have refined and improved our efforts. The lasting value and impact of this endeavor will not be primarily in the words on the pages of the Report, but will come from the conversations that continue and the collaborations that emerge from them.

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Particular thanks are due to the following individuals who gave formal presentations at our meetings: Samuel Corsi from the New York State Education Department on the *New Compact for Learning*; Robert Orrill from the College Board on the SAT's and the new *Pacesetter* program; Larry Hartshorn from Ohio State University on the Ohio Early College Mathematics Placement Testing Program; John Murphy from the State Education Department on state testing and the Regents examination system; Robert Picken, Chair of the Faculty Senate of the City University of New York, on their College Preparatory Initiative; Ray Sullivan and Donald Carstensen of ACT on their Achievement Testing Program; and David Lehman, Principal of the Alternative Community School in Ithaca, New York, on authentic assessment in practice. Throughout this endeavor Robert Picken and Ronald Berkman, Dean of Urban Affairs, kept us well informed of CUNY's progress in their parallel initiative and taught us much.

As with all such endeavors, key staff members made the work of the whole group possible. Barbara Gitenstein and Kevin Reilly were the major writers and editors, bringing clarity and focus to the widely divergent styles of half a dozen subcommittee reports and as many drafts of the final document you now hold. Kathryn Van Arnam gathered and compiled the voluminous materials we needed and produced and organized the visits of our speakers and consultants. Georgianne Crabill handled the innumerable arrangements and unimaginable paperwork necessary for over fifty people from across the state to come together on six occasions in three different locations.

The members of this Task Force and the school teachers and counselors who joined us have given an extraordinary effort of service on behalf of the State University. As Chair of the Task Force, it was a singular privilege to work with professionals so committed to the future of their students and to the future students of our University.

Richard S. Jarvis
Vice Provost for Academic Programs & Research

APPENDIX A

Principles of *A New Compact for Learning*

The New Compact for Learning and the system to which it gives rise are based on certain fundamental principles:

1. All the Children Can Learn

All children are capable of learning and contributing to society. No child should be permitted to fail.

2. Focus on Results

Our mission is not to keep school — it is to see that children learn. The energies of all participants should be focused on achieving the desired outcomes. Accountability does not end with following established rules and procedures; its essence is found in results.

3. Aim for Mastery

Minimum competence, while necessary, is not enough. Successful participation in our society demands much more. All children are entitled to a curriculum, to instructional methods, and to adult expectations which challenge them to perform at their best, and help them to become truly proficient in knowledge and skill.

4. Provide the Means

Every child in New York State is entitled to the resources necessary to provide the sound, basic education which the State Constitution requires. The requirement is not equality of input, but equity of outcome.

5. Provide Authority with Accountability

Each participant in the educational system should have the authority needed to discharge effectively his or her responsibility, and each participant should be held accountable for achieving the desired results. This principle applies to all participants in the educational process — students, parents, teachers, counselors, librarians, administrators, Board of Education members, others.

6. Reward Success and Remedy Failure

Achievement of desired results by individuals and groups should be rewarded. The existing system tends to reward those who make no waves. The times demand a system which rewards those who take risks to produce results.

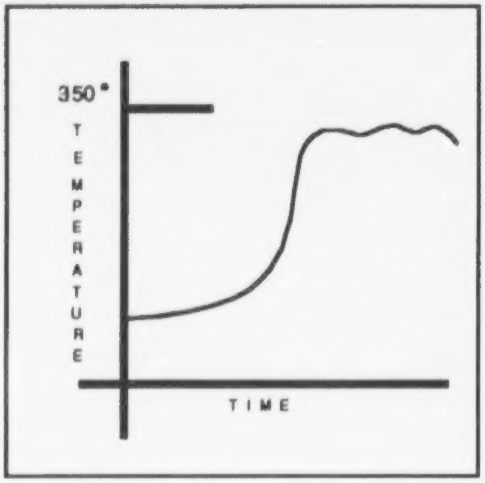
Occasional failure in a large and diverse system is probably unavoidable. However, failure should not be permitted to persist. When it occurs, with either individuals or groups, help should be provided and the situation changed.

Analytical Skills Examples

The following problems require the application of a range of analytical and mathematical skills; some clearly demand relatively sophisticated calculation and reasoning. It would therefore be the very rare high school senior who could "solve" all of these problems. The student who can devise possible methods of solution for a good number of them, however, will demonstrate the analytical abilities fundamental to success in many college courses.

These sample problems have been provided by A. Tucker, J. Winn, and S. Iverson. Some are drawn, and in some instances revised, from *Reshaping School Mathematics* (NRC Mathematical Sciences Education Board, 1990), *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989), and *Introduction to Logic* (I. Copi).

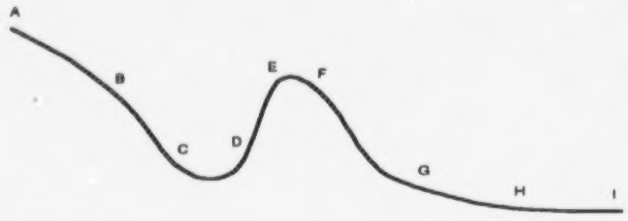
1. What type of common household phenomenon is represented by this graph?



2. Use a calculator to give three different (positive) integers whose product is 7,429. How many different answers can you find? Write a paragraph explaining what you did, why you did it, and how well it worked.

3. An Army bus holds 30 soldiers. If 1,128 soldiers are being bussed to their training site, how many buses are needed?

4. Below is a section of a rollercoaster track. Plot an estimated graph of the relative speed of the rollercoaster at the marked points (assume the rollercoaster is virtually still at point A).



5. Give an expression for the amount of money a_{10} at the end of 10 years in a bank account which earns 8% interest compounded quarterly and starts with a_0 dollars.

6. A cylindrical can is designed to have a volume of one liter. Use exploratory calculations (with a calculator) to determine the optimal radius and height of a cylindrical can to minimize its area.

7. A fair coin is tossed and player A wins a point if it is heads and player B wins a point if it is tails. The first person to get 10 points wins a pizza. The game is interrupted when A has 8 points and B has 7 points. What is the fairest way to divide the pizza according to the rules of this game?

8. Nine robots are to perform various tasks at positions p_1, p_2.....p_9 along an assembly line (where $p_i < p_{i+1}$). Each robot must obtain parts from a single supply bin to be located at some point along the line. Determine where the bin should be located as a function of the p_i's.

9. Prove by induction that $\log(a^n) = n \log(a)$, for any positive integer n.

10. The area under the curve $y = 2^x$ above the x-axis between $x = 1$ and $x = 3$ is to be estimated by two methods:

    A. Find the area of the trapezoid T with corners at $(1,0)$, $(1,2^1)$, $(3,0)$, and $(3,2^3)$.

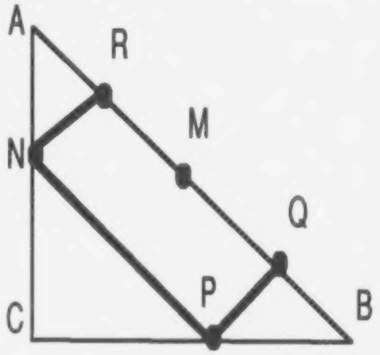
B. Consider the rectangle R with corners at (1,0), (1,8), (3,0), and (3,8). Pick 100 random points inside R and use the fraction of points under the curve to estimate the area under the curve by ________ [complete the description of method B]. Using a calculator or computer with a random number generation routine, use method B. to estimate the area of the curve. How can method A be made more accurate? Is one method likely to give a larger answer than the other?

11. Design an algorithm for evaluating a 4-th degree polynomial involving just four multiplications and four additions (and no exponentiation).

12. Project: Develop an algorithm to determine all roots of a fifth-degree polynomial to any deserved accuracy.

13. Project: Explore the effect on any conic section y = f(x) by a transformation of the form y = af(b+cx) for various a, b, c.

14. In the triangle ABC with hypotenuse AB = 32, let M, N, P be midpoints of sides AB, AC, CB respectively. Further let Q and R be the midpoints of segments BM and MA. Find the perimeter of the quadrilateral NPQR.



15. A ferris wheel with a radius of 25 feet makes a complete revolution of 12 seconds. The bottom of the ferris wheel is 4 feet above the ground. Derive a parametric representation of a point P = (x(t), y(t)) on the rotating ferris wheel as a function of time.

16. Plot the following data about a collection of cars and find a regressing line that best fits this data:

Model Year	'76	'77	'78	'79	'82	'83	'83	'83	'84	'84	'85	'86	'86	'86	'87	'87	'87
Mileage (in 1000's)	141	96	138	120	72	69	68	93	37	47	45	29	28	27	18	17	16

17. Assuming the gas consumption for a particular model of car is normally distributed with mean 25.7 mpg and variance 2.9 mpg, how likely would it be that a particular car of this model gets at least 30 mpg?

18. In a taste-test experiment with 30 people involving three types of cola, 15 choose Brand X, 8 Brand Y, and 7 Brand Z. The manufacturer of Brand X claims that these data show its brand's superiority over the other two. Is this claim reasonable? How likely is it that this outcome could have occurred by chance if on average people like all brands equally well?

19. Comment on the statement: If John and Tom took the SAT's in winter of their junior year and John's combined score was 100 points above Tom's, then when these two take the SAT's in the fall of their senior year, John should be expected to get about 100 points above Tom again.

20. The Mean IQ of the 2,000 students in a high school is 110. Using a truly random sampling method, you select 10 students and find that their mean IQ is 100. Now you select another 10 students at random. What you do expect the mean of the next 10 students to be? What do you expect the mean of the combined 20 students to be?

21. How many different integers between 1 and 30 can be produced as the answer to an arithmetic expression involving the operations of addition, subtraction, multiplication, division, exponentiation, and radicals and each of the digits '1', '9', '8', and '6' (digits cannot be repeated)? For example, 4 can be obtained as the answer to 8+6-1-9, and 3 as $8^{6/9}$-1.

22. Tom, Dick, Harry, and Al are married to May, Jane, Sue and Lisa, although not necessarily in that order. Jan, who is Dick's sister, has four children. Tom and his wife want to wait a few years before starting a family. Tom has never introduced his wife to Sue, who works late hours for Dick (but is not his wife; and May is considering telling Dick's wife to watch out). Dick and Harry, by the way, are twin brothers. Who is married to whom?

23. Write a computer program to generate all numbers from 1 up to 500 that are not divisible by 2, 3, 5, 7, or 11.

24. Two ferries cross a lake 60 miles wide. One ferry is 5 miles per hour slower than the other ferry. If the slower ferry takes one hour longer to cross the lake, what are the speeds of the two ferries?

25. For which positive integers n does $x + 1$ divide $x^n + 1$?

26. Does the equation $x + \sin x = 1$ have solution?

27. How would you determine the length of the diagonal of a rectangular parellelopided for which the length, width, and height are known?

28. The corners of a square are labelled A, B, C, D in clockwise order with A at the upper left corner. A line is drawn from the midpoint of side AD over to corner C. The diagonal from B to D intersects the previous line at a point we call E. What is the ratio of length BE to the length ED?

29. A car moved along a straight road and its speed (in feet per second) was continually increasing. Speedometer readings were recorded at one-second intervals with the following results:

Time	0	1	2	3	4	5
Speed	30	36	38	40	44	50

a) From the above information, can one tell exactly how far the car went in the five seconds?

b) In the first second, what is the minimum distance the car could have travelled? What is the maximum distance?

c) During the entire 5-second interval, what are the minimum and maximum distances the car could have traveled?

30. A company has a budget of $280,000 for computing equipment. Three types of equipment will be purchased: microcomputers at $2,000 each, terminals at $500 each and workstations at $5,000 each. There should be five times as many terminals as microcomputers and two times as many microcomputers as workstations. Set up this problem as a system of three equations in three unknowns and solve.

31. Suppose we are given the following matrices involving the costs of fruits at different stores, the amounts of fruit different types of people want, the number of people of different types in different towns:

	Store A	Store B		Apple	Orange	Pear		Person A	Person B
Apple	.10	.15	Person A	5	10	3	Town 1	1,000	500
Orange	.15	.20	Person B	4	5	5	Town 2	2,000	1,000
Pear	.10	.10							

a) Compute a matrix that tells how much each person's fruit purchases cost at each store.

b) Compute a matrix that tells how many of each fruit will be purchased in each town.

c) Compute a matrix that tells the total cost of everyone's fruit purchases in Town 1 and in Town 2 when people use Store A and when they use Store B (a different number for each town and each store).

32. Suppose that the Drof Motor Company factory requires 7 units of metal, 20 units of labor, 3 units of paint and 8 units of plastic to build a car, while it requires 10 units of metal, 24 units of labor, 3 units of paint, and 4 units of plastic to build a truck. A car sells for $10,000 and a truck for $12,000. The following resources are available: 20,000 units of metal, 5,000 units of labor, 1,000 units of paint, and 1,500 units of plastic. Write a system of linear inequalities expressing the constraints on the number of cars (x) and trucks (y) that can be produced and plot, in x-y space, the region of possible production points (x,y). What production point maximizes the sales value of the cars and trucks produced?

33. There are three prisoners in a jail, one had normal vision, the second had only one eye, and the third was totally blind. The jailer told the prisoners that from a box containing three white hats and two red hats he would select three hats and put one on each prisoner. The prisoners could not see the hat placed on their own head, and they could not see the hats remaining in the box. The prisoners were brought together in a room. The jailer offered freedom to the pris-

oner with normal vision if he could tell what color hat was on his head. The prisoner confessed that he couldn't tell. Next the jailer offered freedom to the prisoner with only one eye if he could tell what color hat was on his head. The second prisoner confessed that he couldn't tell. Much to the jailer's surprise, the blind prisoner claimed that he knew the color of his hat. Assuming that each man reasons correctly, what was the color of the blind man's hat and how was he able to determine it?

34. In a certain mythical country, politicians always lie, and non-politicians always tell the truth. A stranger meets three people from this country, and asks the first of them if he is a politician. The first person answers the question. The second then reports that the first denied being a politician. Then the third asserts that the first is really a politician. How many of these three are politicians?

35. At a dinner party there were five guests as well as the person who gave the party. The names of the guests who sat down at the circular dining room table were Andrew, Barbara, Clifford, Diane, Edward and Frances. One of them was deaf, one was very talkative, one was overweight, one simply hated Diane, one had a vitamin deficiency, and one was the person who gave the party. The person who hated Diane sat directly opposite Barbara. The deaf person sat opposite Clifford, who sat between the guest with the vitamin deficiency and the one who hated Diane. The overweight person sat opposite Andrew, next to the deaf person and to the left of the one who hated Diane. Frances, who was a good friend of everyone, sat next to the overweight person and opposite the person who gave the party. Identify each of the people at this party.

36. The members of a small company are Mr. Black, Mr. White, Mrs. Coffee, Miss Ambrose, Mr. Kelly, and Miss Earnshaw. The positions they occupy are president, vice president, comptroller, attorney, trustee, and director, though not necessarily in that order. The vice president is the president's grandson; the comptroller is the attorney's son-in-law; Mr. Black is not married. Mr. White is twenty-two years old; Miss Ambrose is the trustee's step-sister; and Mr. Kelly is the president's neighbor. None of the unmarried people in the company has children. Who holds each position?

Modern Languages for Communications Syllabus Checkpoints

LISTENING

Checkpoint A

Can comprehend simple statements and questions. Usually comprehends the main idea of extended but simple messages and conversations. Often requires repetition for comprehension even when listening to persons who are used to speaking with non-natives.

Checkpoint B

Can comprehend short conversations on simple topics in everyday situations. Limited vocabulary range necessitates repetitions and/or circumlocutions for understanding. Can understand frequently used tense forms and word-order patterns in simple sentences. Has both general and detailed understanding of short, discrete expressions but has only general understanding of longer conversations and messages within familiar communicative situations. Can sustain comprehension through contextual inferences in short communications on familiar topics with native speakers who are aware of the non-native status of the listener.

Checkpoint C

Can understand standard speech delivered with some repetition and rewording by a native speaker not used to dealing with foreigners. Can understand the essential points of discussions or presentations on familiar topics. Tension, pressure, emotional stress, and unfavorable listening conditions as well as vocabulary and complex utterances may hinder comprehension. Can sometimes detect emotional overtones and understand inferences.

SPEAKING

Checkpoint A

Can initiate and respond to simple statements and engage in simple face-to-face conversation within the vocabulary, structure, and phonology appropriate to the communicative situations and functions of this level. Can be understood, with some repetitions and circumlocutions, by native speakers used to foreigners attempting to speak their language.

Checkpoint B

Can initiate and sustain a conversation, but limited vocabulary range necessitates hesitation and circumlocution. Can use the more common verb tense forms, but still makes many errors in formulation and selection. Can use word order accurately in simple sentences, but still makes errors in more complex patterns. Can sustain coherent structures in short and familiar communicative situations. Can employ selectively basic cohesive features such as pronouns and verb inflections. Extended communication is largely a series of short, discrete utterances. Can articulate comprehensibly but has difficulty in producing certain sounds in certain positions or combinations. Speech is usually labored. Has to repeat to be understood by the general public.

Checkpoint C

Can handle most communicative situations with confidence but may need help with any complication or difficulty. Vocabulary, with some circumlocutions, is sufficient to communicate. Can handle elementary constructions accurately. Limited control of more complex structures may interfere with communication.

READING

Checkpoint A

Can understand simple material for informative or social purposes. Can understand the essential content of short, general, public statements and standardized messages. Can comprehend the main ideas of materials containing simple structure and syntax when relying on visual cues and prior familiarity with the topic. Understanding is limited to simple language containing only the highest frequency grammatical patterns and vocabulary items. Can sometimes guess at cognates and highly contextualized unfamiliar vocabulary. May have to read the material several times in order to achieve understanding.

Checkpoint B

Can understand simple narrative and descriptive authentic materials and edited texts within a familiar context. Has specific comprehension of selected passages in familiar sentence patterns. Can follow essential points and some details of expository writing when dealing with areas of special interest and is able to guess meaning from context.

Checkpoint C

Can understand most factual information in nontechnical prose as well as some expository texts on topics related to areas of special interest. Can read excerpts from literature for pleasure. Is able to separate main ideas from lesser ones and thus begins to analyze materials written for the general public. Is able to use linguistic context and prior knowledge to increase comprehension. Can detect the overall tone or intent of the text.

WRITING

Checkpoint A

Can express basic personal needs and compose short messages on very familiar topics based on personal experience. Writing consists mostly of mastered vocabulary and structures in simple sentences in phrases. Although errors in spelling and grammar are frequent, writing can be understood by native speakers used to dealing with foreigners.

Checkpoint B

Can write simple notes, letters, and short reports using elementary vocabulary and commonly encountered structures. Can express present, future and past ideas comprehensibly. Major errors still occur when expressing more complex thoughts. Begins to develop sequential relationships. Writing is comprehensible to nature speakers used to dealing with foreigners.

Checkpoint C

Can compose unified and organized texts on everyday topics with sufficient vocabulary to express oneself simply with some circumlocution. Is able to show good control of the morphology of the language and of the most frequently used syntactic structures, but errors may still occur. Can express complex ideas sequentially with simple language. Writing is comprehensible to a native speaker not used to reading the writing of foreigners.

CULTURE

Checkpoint A

Has knowledge of some aspects of the target language culture and is aware of the existence of cultures other than his/her own. Is able to function in authentic, common, everyday situations but makes frequent cultural errors that impede communication even with native speakers accustomed to dealing with foreigners.

Checkpoint B

Shows understanding of cultures as systems of values that evolve with time and is able to show how certain values are associated with certain behavior patterns in his/her own culture as well as in the target language culture. On the basis of previous experience with the target language culture, is able to distinguish some culturally authentic patterns of behavior from idiosyncratic behaviors. Still shows misunderstandings in applying this knowledge, and miscommunicates frequently with native speakers not accustomed to foreigners.

Checkpoint C

Shows understanding of most culturally determined behaviors of the target language speakers and begins to demonstrate a general appreciation for their culture. Is generally able to avoid major misunderstandings in common everyday situations with native speakers not accustomed to foreigners. Is able to use the context to guess at the meaning of some unfamiliar cultural behaviors. Shows some initiative and ease in using culturally appropriate behaviors acquired by observation of authentic models.

APPENDIX D

Knowledge Area Standards for Mathematics

These recommendations for knowledge in mathematics are drawn from the document *Curriculum and Evaluation Standards for School Mathematics*, published by the National Council of Teachers of Mathematics (NCTM) Commission on Standards for School Mathematics in 1989. The quality mathematics curricula provided by these standards have been endorsed by the American Association of Physics Teachers, the American Chemical Society, the American Federation of Teachers, the American Mathematics Society, the National Association of Biology Teachers, the National Association of State Boards of Education, the national Congress of Parents and Teachers, the National Education Association, and the National Research Council's Mathematical Sciences Education Board.

Standard 1: Algebra

- Represent situations that involve variable quantities with expressions, equations, inequalities and matrices;
- Use tables and graphs as tools to interpret expressions, equations and inequalities;
- Operate on expressions and matrices; solve equations, inequalities and linear systems;
- Appreciate the power of mathematics abstraction and symbolism;
- Demonstrate technical facility with algebraic transformations, including techniques based on the theory of equations.

Standard 2: Functions

- Model real-world phenomena with a variety of functions;
- Represent and analyze relationships using tables, verbal rules, equations and graphs;
- Translate among tabular, symbolic and graphical representations of functions;
- Recognize that a variety of problem situations can be modeled by the same type of function;
- Analyze the effects of parameter changes on the graphs of functions;

- Understand operations on, and the general properties and behavior of classes of functions.

Standard 3: Geometry from a Synthetic Perspective

- Interpret and draw three-dimensional objects;
- Represent problem situations with geometric models and apply properties of figures;
- Classify figures in terms of congruence and similarity and apply these relationships;
- Deduce properties of, and relationships between, figures from given assumptions;
- Develop an understanding of an axiomatic system through investigating and comparing various geometries.

Standard 4: Geometry from an Algebraic Perspective

- Translate between synthetic and coordinate representations;
- Deduce properties of figures using transformations and using coordinates;
- Identify congruent and similar figures using transformations;
- Analyze properties of Euclidean transformations and related translations to vectors;
- Deduce properties of figures using vectors;
- Apply transformations, coordinates and vectors in problem solving.

Standard 5: Trigonometry

- Apply trigonometry to problem situations involving triangles;
- Explore periodic real-world phenomena using the sine and cosine functions;
- Understand the connection between trigonometric and circular functions;
- Use circular functions to model periodic real-world phenomena;
- Apply general graphing techniques to trigonometric functions;

- Solve trigonometric equations and verify trigonometric identities;
- Understand the connections between trigonometric functions and polar coordinates, complex numbers and series.

Standard 6: Statistics

- Construct and draw inferences from charts, tables and graphs that summarize real-world data;
- Use curve fitting to predict from data;
- Understand and apply measures of central tendency, variability and correlation;
- Understand sampling and recognize its role in statistical claims;
- Design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes;
- Analyze the effects of data transformations on measures of central tendency and variability;
- Transform data to aid in data interpretation and prediction;
- Test hypotheses using appropriate statistics.

Standard 7: Probability

- Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty;
- Use simulations to estimate probabilities;
- Understand the concept of a random variable;
- Create and interpret discrete probability distributions;
- Describe, in general terms, the normal curve and use its properties to answer questions about data sets that are assumed to be normally distributed;
- Apply the concept of a random variable to generate and interpret probability distributions including binomial, uniform, normal and chi square.

Standard 8: Discrete Mathematics

- Represent problem situations using discrete structures such as graphs, matrices, sequences and recurrence relations;

- Represent and analyze graphs using matrices;
- Develop and analyze algorithms;
- Solve enumeration and finite probability problems;
- Represent and solve problems using linear programming and difference equations;
- Investigate problem situations that arise in connection with computation validation and the application of algorithms.

Standard 9: Conceptual Underpinnings of Calculus

- Determine maximum and minimum points of a graph and interpret the results in problem situations;
- Investigate limiting processes by examining infinite sequences and series and areas under curves;
- Understand the conceptual foundations of limit, the area under a curve, the rate of change, and the slope of a tangent line, and their application in other disciplines;
- Analyze the graphs of polynomial, rational, radical and transcendental functions.

Standard 10: Mathematical Structures

- Compare and contrast the real number system and its various subsystems with regard to their structural characteristics;
- Understand the logic of algebraic procedures;
- Appreciate that seemingly different mathematical systems may be essentially the same;
- Develop the complex number system and demonstrate facility with its operations;
- Prove elementary theorems within various mathematical structures, such as groups and fields;
- Develop an understanding of the nature and purpose of axiomatic systems.